# ENVIRONMENTAL ASSESSMENT

COMBUSTION ENGINEERING, INC.
NUCLEAR FUEL FABRICATION PLANT
HEMATITE, MISSOURI

RELATED TO LICENSE RENEWAL OF SPECIAL
NUCLEAR MATERIALS LICENSE NO. SNM-33
DOCKET NO. 70-36

PREPARED BY

DIVISION OF FUEL CYCLE
AND MATERIAL SAFETY

U. S. NUCLEAR REGULATORY COMMISSION

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SUMMARY

This report assesses the environmental consequences of the proposed license renewal of Combustion Engineering's Nuclear Fuel Manufacturing-Hematite (CE) license SNM-33. The assessment has been prepared by the U.S. Nuclear Regulatory Commission (NRC) with the technical assistance of Science Applications, Inc. (SAI) in accordance with the Council On Environmental Quality guidelines contained in the Code of Federal Regulations, Title 40, Part 1506 (40 CFR 1506) and the NRC requirements stipulated in 10 CFR 51.

The radiological consequences of the proposed action were estimated using historical release data, projected releases, local population statistics and meteorological data. These estimates show that the nearest resident will receive, as a result of normal operations, doses which are far below the allowable limits established by the U.S. Environmental Protection Agency.

The radiological consequences of postulated accidents were also examined. Two possible accidents which could involve radiological consequences were examined and analyzed as they appeared to be limiting accidents, i.e., their consequences would be more severe than other accidents considered. The first accident examined involved a potential massive $UF_6$ release which produced $UO_2F_2$ particles of respirable size. The calculated dose to the nearest resident from this accident would be considered minimal. The second accident addressed in the analysis was a nuclear criticality. In the case of this postulated accident doses would be below levels where protective actions are recommended by the U.S. Environmental Protection Agency (EPA) in EPA's "Manual of Protective Action Guides and Protective Action for Nuclear Incidents".

Non-radiological operational consequences were also analyzed. The routine releases of total fluoride, which is a waste product from the $UF_6$ to $UO_2$ conversion process, were examined. With an annual fluoride release rate of 5,600 kilograms, and with the average meteorological conditions, the average concentration of fluoride is less than 0.5 ug/m$^3$ at distances greater than about 500 meters from the release point. This concentration is

that specified by the State of Washington for ambient air and it was used because the State of Missouri has no standards for fluoride.

A hypothetical, non-radiological accidental release of fluoride due to a release of $UF_6$ was examined. This analysis shows that fluoride concentrations which would be experienced by the nearest resident would produce only short-term effects, and possibly be accompanied by taste sensations and mild smarting of the nose.

A second non-radiological accident that was examined postulated the catastrophic failure of the existing ammonia storage cylinder. Estimated offsite consequences of this accident would be limited burned vegetation. No resident fatality would be expected because of the ground hugging nature of ammonia clouds and the elevation of the nearest residents relative to the release point.

The conclusions reached as a result of performing the environmental assessment are:

1. No significant impacts are expected to occur as a result of continued operation of the facility.

2. The greatest environmental risk could be from low probability accidents. The greatest impacts of these accidents, however, would be generally limited to the immediate plant area. No long term consequences to the nearest residents are projected by the assessment.

3. The calculated maximum doses which might result from technetium-99 would be relatively minor, but it appears that some corrective action is appropriate in keeping with the as low as reasonably achievable philosophy (ALARA). It is therefore required that the licensee hasten the decommissioning of the former evaporation ponds to reduce the residual technetium source and to dispose of the contaminated soil by removal and transfer to a commercial disposal site.

Groundwater monitoring should be continued until there is conclusive evidence that radionuclide migration is no longer significant.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

# 1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action (renewal of license SNM-33) is to permit the Combustion Engineering Nuclear Fuel Manufacturing-Hematite (CE) plant to continue to acquire, store, process, and transfer special nuclear material.

The need for the proposed action is to enable the CE plant to continue the manufacture of low-enriched uranium fuels (less than 4.1% U-235) at the nominal annual rate of 225 metric tons of uranium in order to meet the fuel requirements of its customers.

## 2.0 INTRODUCTION

### 2.1 SCOPE

By letter dated January 29, 1982, Combustion Engineering requested that action be taken by the U.S. Nuclear Regulatory Commission on its application for continued operation of the Hematite facility. This environmental assessment of the proposed renewal of the license has been prepared in accordance with the Code of Federal Regulations, Title 10, Part 51 (10 CFR 51), "Licensing and Regulatory Policy and Procedures for Environmental Protection," Sections 51.5, 51.7, 51.20, 51.21, 51.30, and 51.70. This assessment addresses those environmental impacts which will be a result of the proposed action.

The estimated environmental consequences were compared with the appropriate Federal standards and other health guidelines. The specific Federal standards used were: 1) 10 CFR 20.106, "Radioactivity in Effluents in Unrestricted Areas"; 2) 40 CFR 190.10, "Environmental Standards for the Uranium Fuel Cycle"; and 3) 40 CFR 141.11, "Maximum Contaminant Levels For Inorganic Chemicals (National Interim Primary Drinking Water Regulations)". For evaluating the consequences of estimated fluoride releases on humans, the 2500 $ug/m^3$ recommendation of the American Conference of Governmental Industrial Hygienists[1] and guidelines on hydrogen fluoride toxicology were used.[2] The evaluation of fluoride releases on vegetation was made by comparing past and projected performance to the Washington State Standards of 0.5 $ug/m^3$ for ambient air and 40 ppm for forage.[3] These fluoride levels were used in evaluating this proposed action because the State of Missouri has no fluoride standards.

### 2.2 ASSESSMENT ACTIVITIES

During assessment preparation, applicable Federal and State legislation and Federal guidelines were reviewed. Appropriate Federal and State agencies were contacted in person, by phone or by mail. Conferences were held with facility management and staff. A site inspection, including surrounding areas, was conducted. Data from the site visit, legislative review and personnel contacts were collected, evaluated and analyzed for incorporation into the final product.

## 2.3 ORGANIZATION

This assessment is organized according to the guidelines established by the President's Council on Environmental Quality (40 CFR 1506) and the U.S. Nuclear Regulatory Commission (10 CFR 51). Part 3.0 describes the Proposed Action, including alternatives. Part 4.0 identifies the environmental components affected by the proposed action and the alternatives, and evaluates, in qualitative terms, the proposed and alternative actions. Part 5.0 addresses the environmental consequences of the Proposed Action. Part 6.0 presents the staff conclusion regarding safeguards-related environmental impact of the proposed action.

## 3.0 PROPOSED ACTION INCLUDING ALTERNATIVES

### 3.1 PLANT LICENSING HISTORY

The Hematite facility was built by Mallinckrodt Chemical Works to manufacture both high- and low-enriched uranium oxide from $UF_6$. The AEC licensed the facility in March 1956 under Material License No. SNM-33. After a succession of owners[4], the license was then transferred to Combustion Engineering, Inc. in July 1974. Since then, the plant has produced only low-enriched uranium nuclear fuel.

Previous licensing activities were fully described in the Environmental Impact Appraisal prepared in March 1977.[4] Since 1977, eight amendments to CE's license have been granted by NRC. Only two of these amendments are relevant to environmental impacts and therefore are included in this assessment. Amendment No. 2 (September 19, 1977) authorized operation of the wet scrap recovery process without discharging any liquid waste to the onsite evaporation ponds. Amendment No. 4 (October 26, 1979) authorized operation of the incinerator for waste and scrap material. These two amendments constitute the only changes in facility operation which bear on environmental impacts and are addressed in this assessment. An additional amendment has been proposed which involves a major plant expansion but, to date, no action has been taken toward implementation of the expansion program.

### 3.2 PROPOSED ACTION

Combustion Engineering (CE) owns and operates the manufacturing facility which converts uranium hexafluoride ($UF_6$) to uranium dioxide ($UO_2$). This facility presently has a nominal capacity of 225 metric tons of uranium per year. The proposed action is the renewal of the operating license (SNM-33) for the CE plant.

#### 3.2.1 Site Description

The Combustion Engineering Hematite site is located in Jefferson County, Missouri, approximately 56 kilometers (35 miles) southwest of the city of St. Louis. Figure 3.1 indicates the location of Jefferson County within the State of Missouri and its relationship to the major population centers. Figure 3.2 illustrates an expanded section of the area within an 8 kilometer (5-mile) radius of the site and shows its relationship to the local population centers. The figure also shows that the CE plant is located about 800 meters (one-half mile) northeast of the town of Hematite, Missouri. The road connecting the town and the plant is highway 21A which follows Joachim Creek between the towns of Festus/Crystal City and DeSoto.

The plant site consists of 0.62 square kilometer (152 acres). About 3% of the property is currently being used, while the remaining 97% consists of woodlands, water bodies, streams and open spaces. A detailed description of plant buildings and facilities is provided in the Environmental Impact Appraisal of March 3, 1977[4] and no building changes have occurred since that time. Figure 3.3 shows the location of these buildings and identifies their functions in general terms.

Demography

The most recent population data (U. S. Census, 1980) indicate that the population density of the county has increased to an average of 84 persons per square kilometer based on a total population of 145,924. This is up 38% from that reported in 1975. As shown in Figure 3.2, several towns and unincorporated settlements are wholly or partly within the 8 kilometer (5-mile) radius of the Hematite site. The nearest residents are located about 800 meters (one-half mile) to the southwest. Hematite is the nearest unincorporated town, and Festus/Crystal City is the nearest town of significant size. The latter is located 5.6 kilometers (3.5 miles) east of the site and has a population of about 11,000 people.

Present populations in the 16 cardinal compass point sectors at various radial intervals from the plant, to a distance of 80 kilometers (50 miles), are shown in Figure 3.4. The rural nature of the area is evident from the low population density values near the plant site.

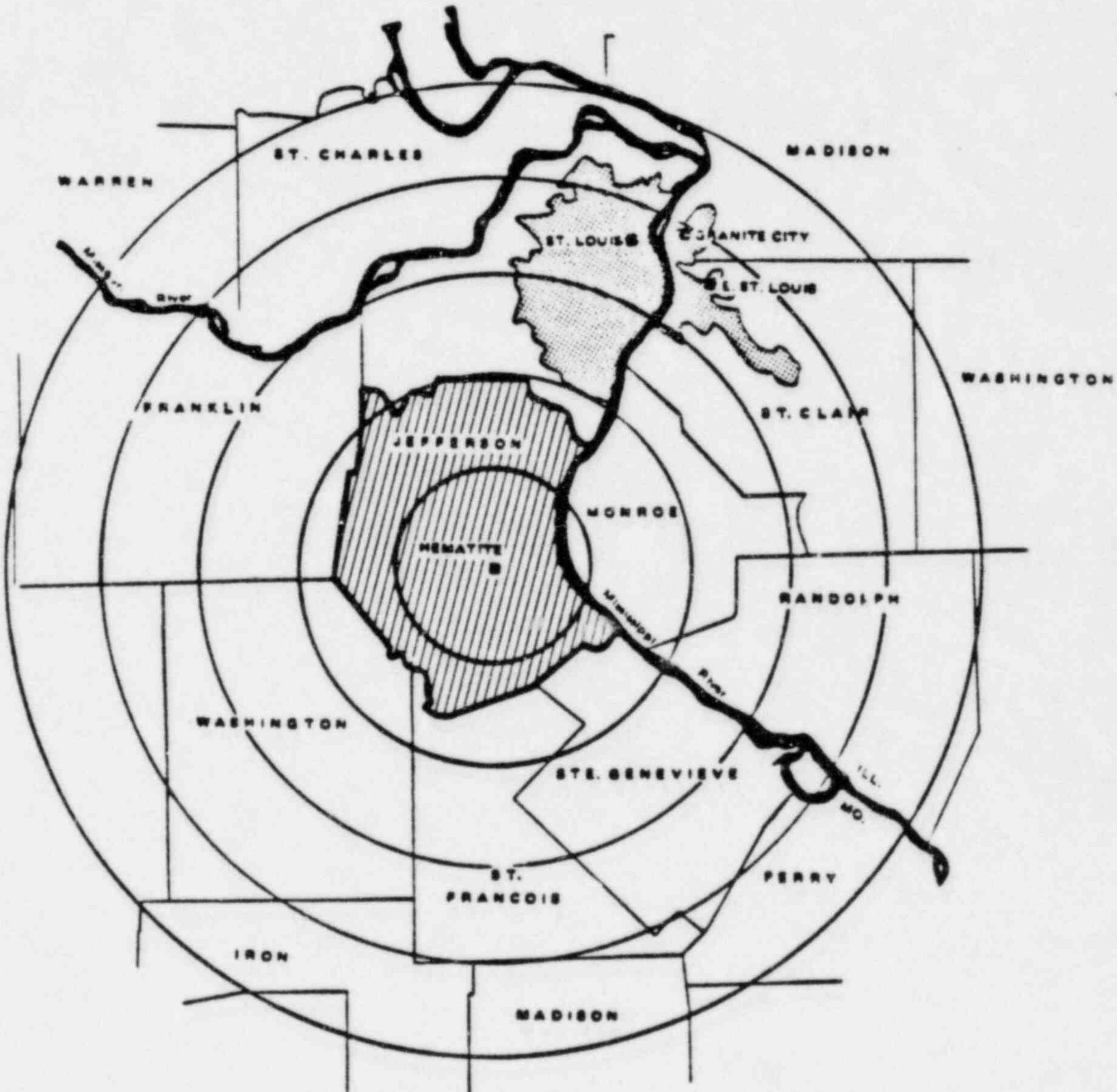



Figure 3.1 Location of Jefferson County and Hematite
(10 mile radius rings)

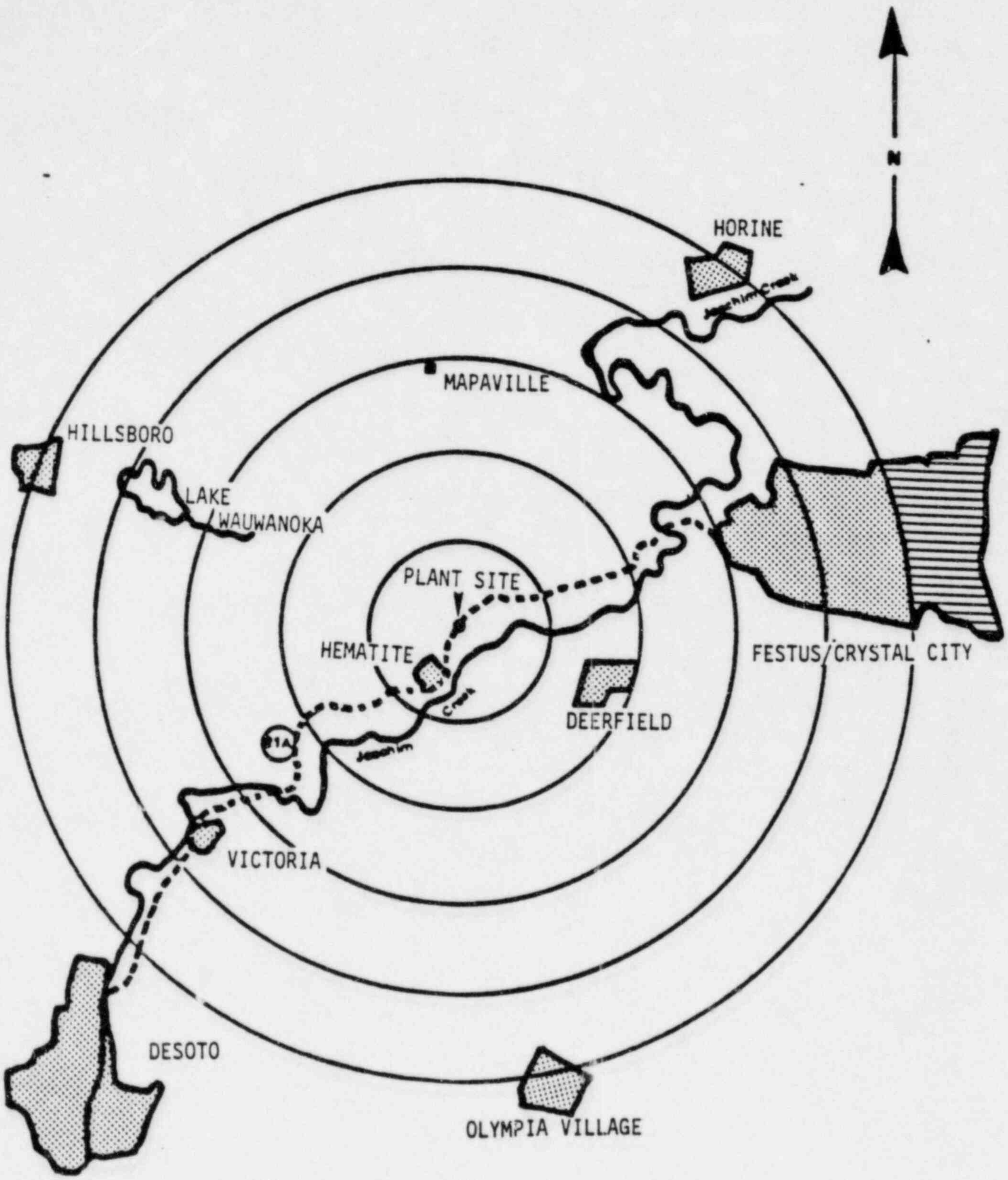
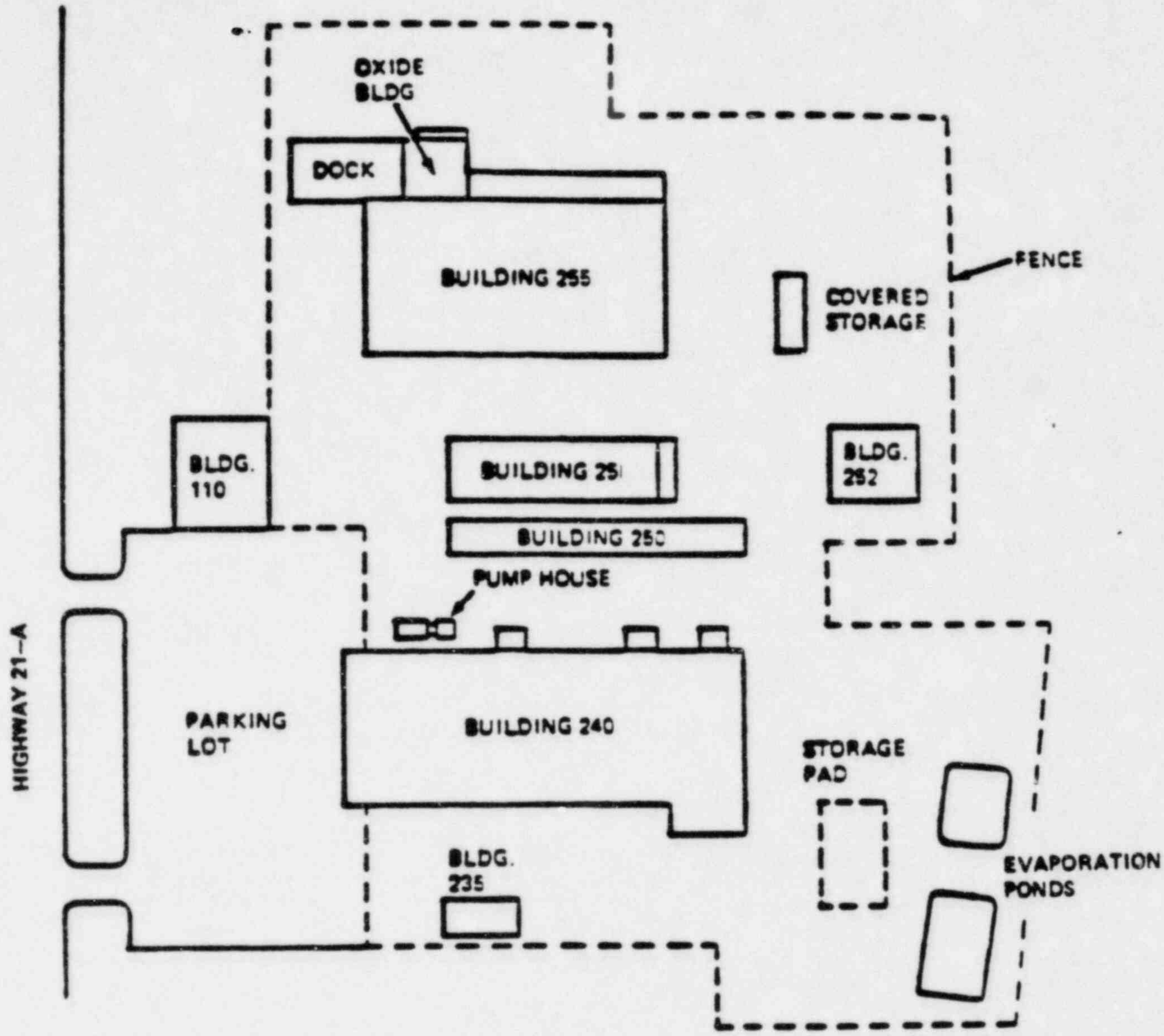



Figure 3.2 Area Features within an 8 kilometer (5 mile) Radius of the Hematite Facility




| Buildings and Facilities on the CE Hematite Site | | |
|---|---|---|
| **Building No.** | **Building Name** | **Present Utilization** |
| —— | Pump House | Site Water Supply |
| 110 | New Office Building | Guard Station and Offices |
| —— | Oxide Building and Dock | $UF_6$ to $UO_2$ Conversion |
| 235 | West Vault | Natural and Depleted Uranium Storage |
| 240 | 240–1 | Office and Cafeteria |
| | 240–2 and 3 | Recycle and Recovery Area |
| | 240–4 | Laboratory and Maintenance Shop |
| 250 | Boiler Room/Warehouse | Steam Supply and Storage |
| 252 | South Vault | Radioactive Waste Storage |
| 255 | Pellet Plant | Fuel Pellet Fabrication, $UO_2$ Storage and Laundry |

Figure 3.3 Location and Identification of Buildings and Facilities

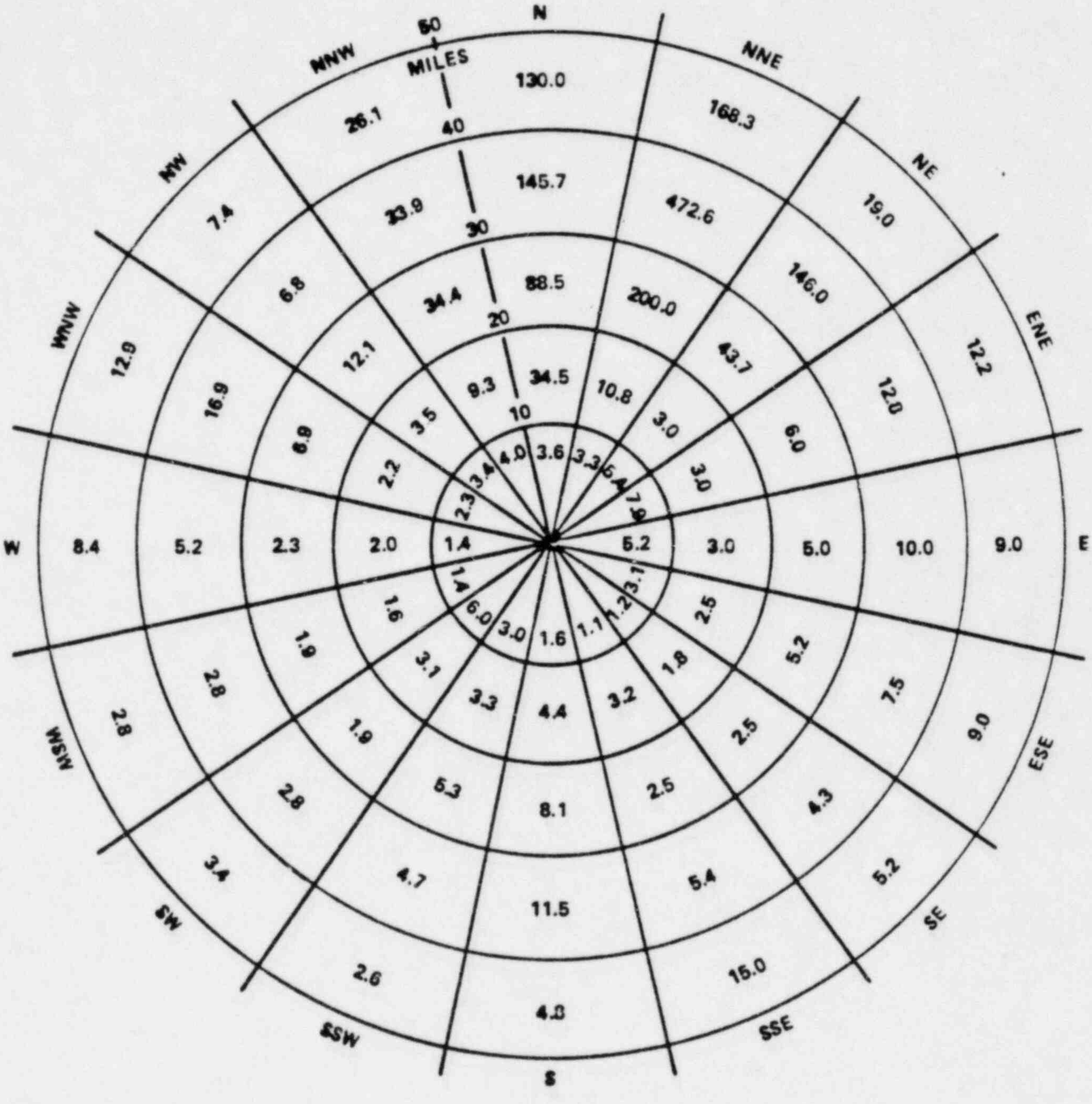



Figure 3.4 Population Distribution Within 80 Kilometers (50 miles) of the Hematite Site

## Land Use

Jefferson County remains predominantly rural and is characterized by rolling hills with many sizable woodland tracts. Fifty percent of the land is classified as forest, 39% as agricultural with crops such as grain and hay, and approximately 11% as urban, suburban, commercial and unused or undeveloped.[4]

The county is part of a dynamic growing urban region of the St. Louis Standard Metropolitan Statistical Area (SMSA). Although extensive development has resulted from its growth, agricultural land use is still predominant in the site's environs.[5] Some areas, as close as 800 meters (one-half mile) from the plant site, have been developed as small residential subdivisions within the past decade.

## Meteorology

General climatological characteristics in the area can be approximated by the U.S. Weather Bureau recording station at St. Louis which is about 35 miles NNE of the site. Both locations are near the Mississippi River and the geographical center of the United States. The region experiences a modified continental climate without prolonged periods of extreme cold, extreme heat or high humidity. To the south is the warm, moist air of the Gulf of Mexico, and to the north, Canada is a source of cold air masses. The alternate invasion of the region by air masses from these sources produces a variety of weather conditions, none of which is likely to persist for any length of time.

Winters are brisk but seldom severe. Snowfall has averaged less than 20 inches per winter season since 1930. Minimum temperatures remain as cold as 32°F or lower fewer than 20 to 25 days in most years. Summers are warm with a maximum temperature of 90°F or higher an average of 35 to 40 days per year. The normal average annual precipitation for the St. Louis area is a little over 35 inches. The three winter months are the driest, the spring months are normally the wettest and it is not unusual to have an extended period of 1 to 2 weeks or more without appreciable rainfall from the middle of the summer into the fall.

Thunderstorms occur on the average between 40 to 50 days per year. During any year there are usually a few of these that can be classified as severe storms with hail and damaging winds. The U.S. Department of Commerce reports a mean annual frequency of about 8 tornadoes per year for a 30-year period. Eight tornadoes were reported in the State of Missouri in 1979. The probability of a tornado striking this particular location is computed as $7.51 \times 10^{-4}$ and the recurrence interval is 1,331 years.[6]

Onsite meteorological data on wind speeds and direction is not available from the applicant. However, general climatological characteristics in the area can be referenced to the U.S. Weather Bureau recording station at St. Louis.[7]

For subsequent atmospheric dispersion calculations, joint frequency distribution of wind direction, speed and stability class from observations made at St. Louis were used. The meteorological dispersion factors (Cni/Q), were produced from the Gaussian Plumme model and diffusion coefficients for Pasquill type turbulence as described in Regulatory Guide 1.111. In evaluating the annual average Chi/Q values, a ground level release was conservatively assumed with no correction for building wake effects. The annual average Chi/Q's as a function of distance up to 50 miles from the site in the sixteen 22-1/2 degree compass point sectors were calculated and are shown in Table 3.1.

Hydrology - Surface Water

Figure 3.2 shows Joachim Creek as the major surface water feature in the vicinity of the Hematite site. This stream meets state water quality standards.[8] The United States Department of the Interior, Geological Survey, maintains a flow gauge at the Route 21A bridge crossing the Joachim Creek at Hematite. Only a small number of observations have been taken but data indicate that the annual mean flow is about 3.7 cubic meters per second ($m^3/s$). The seasonal mean flows are: spring - 9.3 $m^3/s$, summer - 0.3 $m^3/s$, fall - 0.4 $m^3/s$, winter - 4.7 $m^3/s$.

Discharges of industrial waste water and sanitary sewage water from the plant presently amount to about .006 $m^3/s$ and therefore increase the average flow in Joachim Creek by only a small percentage

Table 3.1 Annual Chi/Qs for the St. Louis Area

NORMAL RELEASE
NO DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) — DISTANCE INMILES

| SECTOR | 0.250 | 0.500 | 0.750 | 1.000 | 1.500 | 2.000 | 2.500 | 3.000 | 3.500 | 4.000 | 4.500 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 5.716E-06 | 1.646E-06 | 7.977E-07 | 4.913E-07 | 2.559E-07 | 1.638E-07 | 1.168E-07 | 8.894E-08 | 7.084E-08 | 5.829E-08 | 4.914E-08 |
| SSW | 7.349E-06 | 2.118E-06 | 1.022E-06 | 6.309E-07 | 3.309E-07 | 2.133E-07 | 1.530E-07 | 1.172E-07 | 9.303E-08 | 7.754E-08 | 6.563E-08 |
| SW | 9.981E-06 | 2.881E-06 | 1.389E-06 | 8.578E-07 | 4.517E-07 | 2.923E-07 | 2.103E-07 | 1.616E-07 | 1.297E-07 | 1.074E-07 | 9.110E-08 |
| WSW | 7.992E-06 | 2.302E-06 | 1.110E-06 | 6.848E-07 | 3.595E-07 | 2.320E-07 | 1.666E-07 | 1.277E-07 | 1.023E-07 | 8.462E-08 | 7.168E-08 |
| W | 9.408E-06 | 2.715E-06 | 1.311E-06 | 8.091E-07 | 4.251E-07 | 2.745E-07 | 1.971E-07 | 1.512E-07 | 1.211E-07 | 1.002E-07 | 8.488E-08 |
| WNW | 1.238E-05 | 3.572E-06 | 1.725E-06 | 1.064E-06 | 5.585E-07 | 3.602E-07 | 2.585E-07 | 1.981E-07 | 1.586E-07 | 1.312E-07 | 1.110E-07 |
| NW | 1.871E-05 | 5.408E-06 | 2.608E-06 | 1.612E-06 | 8.500E-07 | 5.504E-07 | 3.965E-07 | 3.047E-07 | 2.447E-07 | 2.027E-07 | 1.720E-07 |
| NNW | 1.365E-05 | 3.950E-06 | 1.913E-06 | 1.181E-06 | 6.194E-07 | 3.991E-07 | 2.861E-07 | 2.190E-07 | 1.752E-07 | 1.447E-07 | 1.224E-07 |
| N | 1.350E-05 | 3.910E-06 | 1.902E-06 | 1.172E-06 | 6.105E-07 | 3.907E-07 | 2.785E-07 | 2.121E-07 | 1.689E-07 | 1.389E-07 | 1.171E-07 |
| NNE | 6.350E-06 | 1.839E-06 | 8.944E-07 | 5.505E-07 | 2.863E-07 | 1.830E-07 | 1.303E-07 | 9.914E-08 | 7.890E-08 | 6.485E-08 | 5.463E-08 |
| NE | 7.229E-06 | 2.087E-06 | 1.011E-06 | 6.224E-07 | 3.242E-07 | 2.076E-07 | 1.481E-07 | 1.129E-07 | 9.002E-08 | 7.411E-08 | 6.252E-08 |
| ENE | 1.015E-05 | 2.928E-06 | 1.414E-06 | 8.720E-07 | 4.569E-07 | 2.942E-07 | [illegible] | 1.615E-07 | 1.292E-07 | 1.068E-07 | 9.035E-08 |
| E | 1.723E-05 | 4.975E-06 | 2.399E-06 | 1.482E-06 | 7.802E-07 | 5.049E-07 | 3.635E-07 | 2.792E-07 | 2.241E-07 | 1.857E-07 | 1.575E-07 |
| ESE | 1.463E-05 | 4.226E-06 | 2.045E-06 | 1.262E-06 | 6.613E-07 | 4.256E-07 | 3.049E-07 | 2.332E-07 | 1.865E-07 | 1.539E-07 | 1.302E-07 |
| SE | 8.918E-06 | 2.575E-06 | 1.251E-06 | 7.709E-07 | 4.012E-07 | 2.564E-07 | 1.825E-07 | [illegible] | 1.105E-07 | 9.077E-08 | 7.644E-08 |
| SSE | 5.796E-06 | 1.673E-06 | 8.131E-07 | 5.004E-07 | 2.599E-07 | 1.659E-07 | 1.180E-07 | 8.965E-08 | 7.127E-08 | 5.853E-08 | 4.926E-08 |

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) — DISTANCE IN MILES

| BEARING | 5.000 | 7.500 | 10.000 | 15.000 | 20.000 | 25.000 | 30.000 | 35.000 | 40.000 | 45.000 | 50.000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 4.224E-08 | 2.381E-08 | 1.597E-08 | 9.190E-09 | 6.256E-09 | 4.657E-09 | 3.666E-09 | 2.999E-09 | 2.522E-09 | 2.166E-09 | 1.892E-09 |
| SSW | 5.662E-08 | 3.238E-08 | 2.194E-08 | 1.281E-08 | 8.804E-09 | [illegible] | 5.228E-09 | 4.297E-09 | 3.629E-09 | 3.125E-09 | 2.742E-09 |
| SW | 7.873E-08 | 4.531E-08 | 3.085E-08 | 1.813E-08 | 1.251E-08 | [illegible] | 7.472E-09 | 6.154E-09 | 5.207E-09 | 4.493E-09 | 3.944E-09 |
| WSW | 6.188E-08 | 3.548E-08 | 2.409E-08 | 1.411E-08 | 9.718E-09 | 7.300E-09 | 5.789E-09 | 4.764E-09 | 4.028E-09 | 3.475E-09 | 3.047E-09 |
| W | 7.327E-08 | 4.199E-08 | 2.850E-08 | 1.667E-08 | 1.147E-08 | 8.611E-09 | 6.824E-09 | 5.613E-09 | 4.743E-09 | 4.091E-09 | 3.585E-09 |
| WNW | 9.582E-08 | 5.484E-08 | 3.719E-08 | 2.173E-08 | 1.495E-08 | 1.122E-08 | 8.886E-09 | 7.306E-09 | 6.172E-09 | 5.322E-09 | 4.664E-09 |
| NW | 1.487E-07 | 8.561E-08 | 5.831E-08 | 3.427E-08 | 2.365E-08 | 1.779E-08 | 1.412E-08 | 1.163E-08 | 9.843E-09 | 8.498E-09 | 7.455E-09 |
| NNW | 1.055E-07 | 6.016E-08 | 4.067E-08 | 2.366E-08 | 1.622E-08 | 1.213E-08 | 9.592E-09 | 7.873E-09 | 6.641E-09 | 5.719E-09 | 5.005E-09 |
| N | 1.006E-07 | 5.658E-08 | 3.789E-08 | 2.174E-08 | 1.476E-08 | 1.097E-08 | 8.617E-09 | 7.037E-09 | 5.910E-09 | 5.070E-09 | 4.422E-09 |
| NNE | 4.692E-08 | 2.636E-08 | 1.764E-08 | 1.011E-08 | 6.863E-09 | 5.097E-09 | 4.004E-09 | 3.269E-09 | 2.745E-09 | 2.354E-09 | 2.053E-09 |
| NE | 5.377E-08 | 3.039E-08 | 2.043E-08 | 1.179E-08 | 8.045E-09 | 5.999E-09 | 4.729E-09 | 3.872E-09 | 3.259E-09 | 2.802E-09 | 2.448E-09 |
| ENE | 7.793E-08 | 4.452E-08 | 3.015E-08 | 1.759E-08 | 1.209E-08 | 9.070E-09 | 7.183E-09 | 5.904E-09 | 4.986E-09 | 4.299E-09 | 3.766E-09 |
| E | 1.361E-07 | 7.836E-08 | 5.337E-08 | 3.136E-08 | 2.165E-08 | 1.629E-08 | 1.294E-08 | 1.066E-08 | 9.019E-09 | 7.787E-09 | 6.833E-09 |
| ESE | 1.122E-07 | 6.386E-08 | 4.314E-08 | 2.506E-08 | 1.717E-08 | 1.285E-08 | 1.015E-08 | 8.331E-09 | 7.026E-09 | 6.050E-09 | 5.295E-09 |
| SE | 6.564E-08 | 3.694E-08 | 2.463E-08 | 1.410E-08 | 9.558E-09 | 7.093E-09 | 5.569E-09 | 4.545E-09 | 3.815E-09 | 3.272E-09 | 2.853E-09 |
| SSE | 4.227E-08 | 2.368E-08 | 1.581E-08 | 9.036E-09 | 6.121E-09 | 4.539E-09 | 3.562E-09 | 2.905E-09 | 2.438E-09 | 2.089E-09 | 1.821E-09 |

CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT — SEGMENT BOUNDARIES IN MILES

| DIRECTION FROM SITE | .5-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-10 | 10-20 | 20-30 | 30-40 | 40-50 |
|---|---|---|---|---|---|---|---|---|---|---|
| S | 8.500E-07 | 2.673E-07 | 1.182E-07 | 7.123E-08 | 4.929E-08 | 2.442E-08 | 9.393E-09 | 4.687E-09 | 3.008E-09 | 2.170E-09 |
| SSW | 1.092E-06 | 3.453E-07 | 1.548E-07 | 9.430E-08 | 6.582E-08 | [illegible] | 1.306E-08 | 6.640E-09 | 4.309E-09 | 3.134E-09 |
| SW | 1.484E-06 | 4.711E-07 | 2.127E-07 | 1.303E-07 | 9.135E-08 | 4.631E-08 | 1.846E-08 | 9.462E-09 | 6.170E-09 | 4.502E-09 |
| WSW | 1.166E-06 | 3.751E-07 | 1.685E-07 | 1.028E-07 | 7.189E-08 | 3.628E-08 | 1.438E-08 | 7.341E-09 | 4.776E-09 | 3.480E-09 |
| W | 1.400E-06 | 4.435E-07 | 1.994E-07 | 1.217E-07 | 8.512E-08 | 4.294E-08 | 1.699E-08 | 8.660E-09 | 5.628E-09 | 4.097E-09 |
| WNW | 1.842E-06 | 5.828E-07 | 2.615E-07 | 1.594E-07 | 1.114E-07 | 5.610E-08 | 2.215E-08 | 1.128E-08 | 7.325E-09 | 5.330E-09 |
| NW | 2.788E-06 | 8.863E-07 | 4.008E-07 | 2.458E-07 | 1.725E-07 | 8.749E-08 | 3.489E-08 | 1.789E-08 | 1.166E-08 | 8.510E-09 |
| NNW | 2.040E-06 | 6.463E-07 | 2.894E-07 | 1.761E-07 | 1.228E-07 | 6.158E-08 | 2.413E-08 | 1.221E-08 | 7.895E-09 | 5.728E-09 |
| N | 2.024E-06 | 6.376E-07 | 2.819E-07 | 1.698E-07 | 1.174E-07 | 5.805E-08 | 2.222E-08 | 1.104E-08 | 7.059E-09 | 5.079E-09 |
| NNE | 9.515E-07 | 2.991E-07 | 1.319E-07 | 7.933E-08 | 5.480E-08 | 2.705E-08 | 1.034E-08 | 5.130E-09 | 3.279E-09 | 2.358E-09 |
| NE | 1.077E-06 | 3.387E-07 | 1.499E-07 | 9.050E-08 | 6.272E-08 | 3.116E-08 | 1.204E-08 | 6.037E-09 | 3.884E-09 | 2.806E-09 |
| ENE | 1.510E-06 | 4.768E-07 | 2.134E-07 | 1.299E-07 | 9.062E-08 | 4.556E-08 | 1.794E-08 | 9.121E-09 | 5.920E-09 | 4.305E-09 |
| E | 2.564E-06 | 8.137E-07 | 3.675E-07 | 2.252E-07 | 1.579E-07 | 8.009E-08 | 3.194E-08 | 1.638E-08 | 1.069E-08 | 7.799E-09 |
| ESE | 2.182E-06 | 6.900E-07 | 3.084E-07 | 1.874E-07 | 1.306E-07 | 6.539E-08 | 2.557E-08 | 1.292E-08 | 8.354E-09 | 6.059E-09 |
| SE | 1.332E-06 | 4.190E-07 | 1.847E-07 | 1.111E-07 | 7.669E-08 | 3.781E-08 | 1.442E-08 | 7.141E-09 | 4.560E-09 | 3.278E-09 |
| SSE | 8.652E-07 | 2.716E-07 | 1.194E-07 | 7.167E-08 | 4.942E-08 | 2.432E-08 | 9.246E-09 | 4.570E-09 | 2.915E-09 | 2.093E-09 |

(0.16%). A more significant addition is made by an onsite spring which also empties into Joachim Creek at the rate of 0.02 $m^3/s$ (0.58% increase).

The possibility of flooding at the CE Hematite plant site has been considered. Floodplain inundation can become an item of concern if 1) the structures located in the floodplain alter the floodplain's natural operation during this condition, or 2) the structures or material storage containers on the floodplain are damaged and uranium is dispersed. The following paragraphs address both of these concerns.

An evaluation of Joachim Creek at the site of the CE facility was performed by the St. Louis District Corps of Engineers[9]. This evaluation stated that the maximum elevation of the one percent chance flood (100-year recurrence interval) would be 132.5 meters (434.7 feet) above mean sea level (msl). Should such an inundation occur, the floors of buildings 235, 240, 250, and 252 (Figure 3.3) would be flooded to a depth of about 6 centimeters (cm).

The high-water level for the area's worst recorded flood (1844) was approximately 124.6 meters (409 feet) msl. The highest water level in more recent years (1954) was 120.4 meters (395 feet) above msl. The Hematite site is located approximately 132.3 meters (434 feet) above msl. Thus, the possibility of flooding at the site is considered to be remote. The plant, which began operation in 1956, was constructed prior to the issuance of Executive Order 11296, "Flood Hazard Evaluation," and is located on the floodplain of Joachim Creek. Executive Order 11988, "Floodplain Management," contains guidelines for obviating flooding hazard and protecting the natural functions and beneficial values of floodplains. Despite having been built prior to publication of these guidelines, the plant will not affect the natural functioning of the floodplain because of its size and location at the extreme western edge of the floodplain area. The plant site occupies only 1.8 percent of the 1.1 square kilometers (275 acres) of the floodplain area between the Hematite bridge and a point 1.6 kilometers (1 mile) downstream of the plant. The floods which occur in the area are of short duration because of the limited drainage area of Joachim Creek at the plant site. A typical flood will be at a peak height for about one-half hour.

The second concern associated with the proposed action is that a severe flood might transport uranium away from the plant site and result in off-site contamination and radiation exposure. Transport could take place only if inundation occurred, if flood velocities were significant, and if there were significant quantities of exposed material available for transport. The following paragraph examines the nature of floods which might occur at the site and relates these to material release and transport potential.

Floods which might occur at the site will produce different flood levels depending upon the flow rate of Joachim Creek. While the historical records (maximum recorded level of 124.6 meters msl (409 ft.)) as well as the analysis by U.S. Corps of Engineers (100-year flood level at 132.5 meters msl) show that a site flood is not likely, it still is considered remotely possible. If a flood greater than 132.5 meters msl (437.7 ft.) were to occur, water at the plant site would rise, but any significant water velocity associated with the flooding would not be expected. The reason for the minimal water velocity is that the railroad track which is located between Joachim Creek and the plant would serve to isolate the plant area from the main stream flow. Water would enter and exit this isolated area via a culvert 275 meters south of the plant boundary and a second one about 370 meters northeast of the plant, both of which pass under the railroad tracks. This postulated flood would be expected to result in only minimal water velocities (less than 3 cm/sec). These velocities are not expected to be able to tip material storage cannisters within the buildings or transport any spilled material. Experimental results for a water-sand system show that for particles of $UO_2$ size, water velocities of greater than 17 cm/sec are required to move the material.[10] Given the increased density of $UO_2$ relative to sand (a factor of about 4) it does not seem likely that a credible flood would spill or transport spilled $UO_2$ particles.

Hydrology - Groundwater

Wells drilled into bedrock aquifers in the Joachim Creek watershed may encounter confined or artesian groundwater. In general, groundwater movement is southeasterly towards Joachim Creek. Yields of wells vary, depending on what rock units are penetrated. Wells finished in St. Peter Sandstone through Lower Gasconade Dolomite have yields of more than 100 gallons per minute while wells finished in Cambrian age sediments but open to Ordovician age sediments have yields up to as much as 500 gallons per minute. Wells drilled in any of these areas could expect to encounter water with acceptable dissolved solids (less than 500 ppm) in or above the aquifer indicated. Water used at the site is supplied by an artesian well located on the property. Daily average water usage for site operations amounts to 71,000 gallons per day (gpd). Withdrawal of this volume of water has no adverse effect on the water table as it represents a very small portion of the available supply, for example: a spring on the property, a few hundred feet from the well, naturally flows at the rate of 500,000 gallons per day.[4]

## Geology

The underlying earth structures are composed on younger rock than those of the southwestern portion of the county. The 240-260 million-year-old Mississippian system of the far northeastern portion of the county gradually changes to the 440-470 million-year-old Cambrian system of the southwestern portion of the county. This difference in age partly explains the difference in topography. The older Cambrian system has been exposed to erosion for 200 million years more than the younger Mississippian system, resulting in a more rolling topography. The younger rock structures of the northeastern section exhibit a more rugged topography.

The southwestern corner of the county near the Big River is primarily dolomite (magnesium limestone), with sandstone and chert (angular fragments of quartz) present in varying quantities depending on the location. This dolomite and chert grades northeast toward St. Louis into dolomite with sandstone. A massive sandstone ridge runs across the county from Pacific southeast to Festus and Crystal City. This fine quality stone is used for glass manufacturing and building purposes. Limestone exists in the Kimnswick formation in a narrow strip across the northern part of the county and extends south along the Mississippi River. Some deposits of marble are also present in the county.

Several test borings have been made in connection with past construction activities at the Hematite site. The borings were drilled to depths of approximately 35 feet. The soil profile thus obtained shows upper alluvial soils of stiff, very silty clays containing some sand, underlain by silty clays of firm to stiff consistency, to depths of 10 to 13.5 feet. Very stiff, highly plastic clay with limestone fragments were next encountered to depths of approximately 22 feet. Firm to stiff, sandy, silty clay was then found until auger refusal was obtained on boulders or limestone bedrock at an approximate depth of 36 feet.

Seismology

The east-central Missouri area is relatively active seismically (Figure 3.5)*. The southeastern corner of the state is quite active seismically and contains the northern portion of the New Madrid Fault (246 kilometers, 153 miles southeast of Hematite) that caused the "great earthquakes" of 1811 and 1812. There were three quakes of Epicentral Intensity XII on the Modified Mercalli (M.M.) scale which took place on December 6, 1811 and January 23 and February 7, 1812 in the immediate area of New Madrid.[11] During the period 1931-1977, one hundred seventy four quakes were recorded in the New Madrid area (i.e., within 96 kilometers, 60 miles) but only three reached M.M. VI intensity.[12] Frequent quakes continue to be recorded in the New Madrid area but are of such low intensity that the majority are below, or barely at, the threshold of human perception and seismological predictions are that a quake of damaging intensity will not occur for another 600 to 1,800 years.[13]

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* The triangles shown in Figure 3.5 indicate the locations of the quake epicenters, the roman numerals indicate the intensity of the most recent quake (M.M. scale), the arabic numbers indicate the number of times a quake has occurred at that location and the date below the triangle is that of the last event.

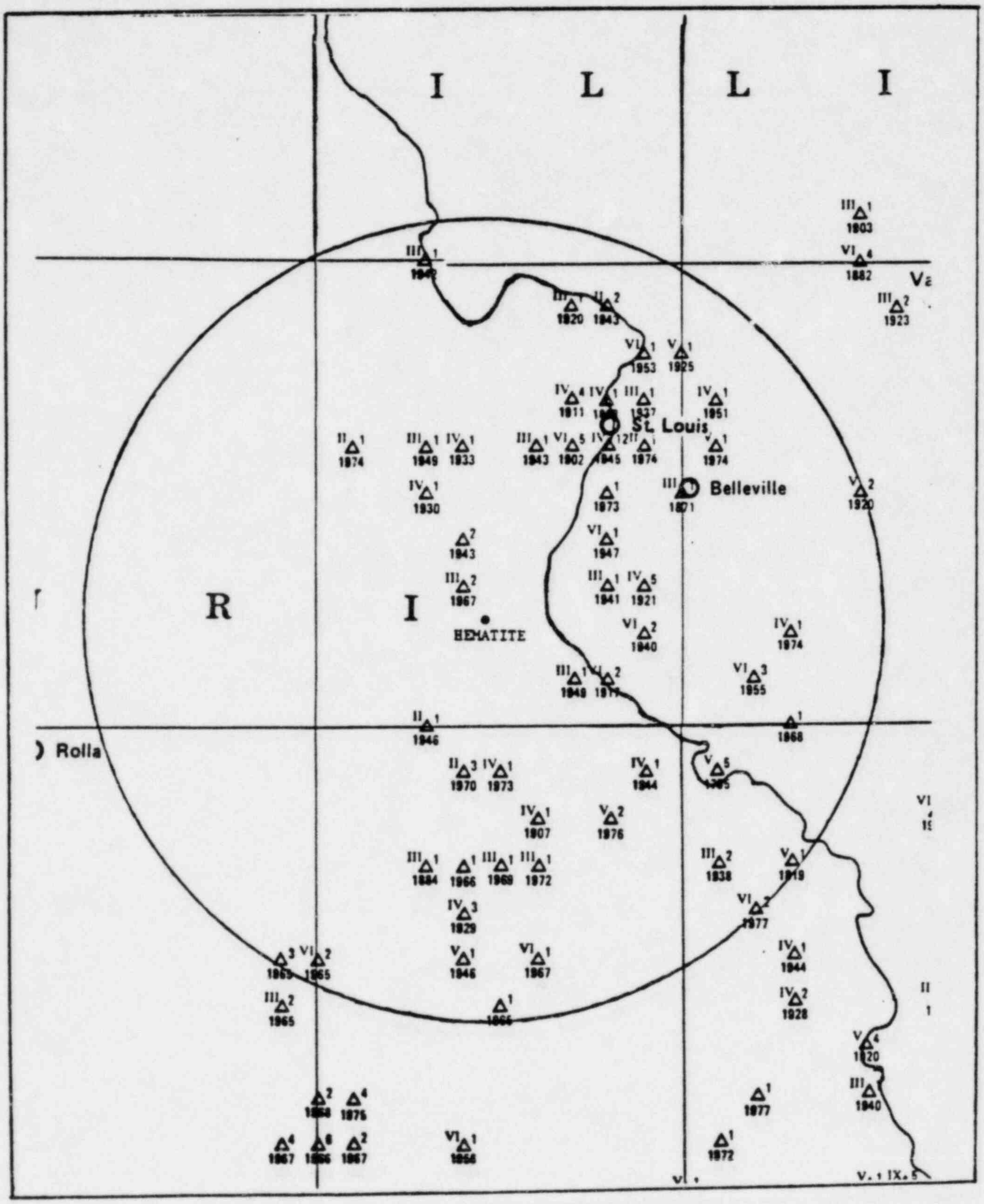


Figure 3.5 Seismicity of East-Central Missouri
(U.S. Geological Survey, 1979)

### 3.2.2 Operation

Plant Processes

Combustion Engineering's Hematite, Missouri, plant produces low-enriched (less than 4.1% U-235) ceramic fuel for light water reactors.

The uranium is initially received as uranium hexafluoride from the enrichment plants and converted to uranium dioxide powder, using the dry conversion fluid bed process. The $UO_2$ powder is either shipped to CE's Windsor Plant for further processing or it is fabricated into ceramic fuel pellets onsite and then shipped to Connecticut for fuel element fabrication.

The enriched uranium hexafluoride is received as a solid in 2.5 ton cylinders. These cylinders are heated in a steam chest to vaporize the $UF_6$. The solid $UF_6$ is vaporized to a gas and, under its own vapor pressure, moves through pipes to the first fluid bed reactor. Here, it is reacted with an excess of dry steam to form fine particles of uranyl fluoride ($UO_2F_2$) and hydrogen fluoride (HF) gas as shown below:

$$UF_6(gas) + 3H_2(gas) \longrightarrow UO_2F_2(solid) + 4HF(gas) + H_2O(gas)$$

$$UO_2F_2(solids) + H_2(gas) \longrightarrow UO_2(solid) + 2HF(gas)$$

The gaseous HF and $H_2O$ exit the reactor through a porous metal filter; the solid $UO_2F_2$ is moved to a second and third reactor where it is pyrohydrolyzed in a reducing atmosphere of "cracked ammonia" to remove any residual fluoride and reduce the $UO_2F_2$. Gases from the second and third reactor are also filtered through porous metal filters and all gaseous reaction products are passed through towers packed with calcium carbonate to remove the HF prior to their release to the atmosphere.

$UO_2$ powder from the third reactor is cooled and pneumatically transferred to storage silos. The powder is withdrawn from the storage silos, milled to a specified particle size range in a fluid energy mill, and pneumatically transferred to blenders prior to use in the pellet plant or shipment to CE's Windsor Plant.

Blended powder from the conversion plant is agglomerated using an organic binder and a suitable solvent. The agglomerated powder is granulated to insure a consistent press feed and pressed to the desired shape. The green pellets are processed through a dewaxing furnace to remove the binder and subsequently sintered to final density in a sintering furnace. The dewaxing and sintering operations are performed in a reducing atmosphere of hydrogen or "cracked ammonia". The sintered pellets are ground to nominal diameter using a centerless grinder, dried, certified, and packed for shipment.

The oxide building is used for converting $UF_6$ to $UO_2$, the latter being the feed material for nuclear fuel fabrication operations. Building 255 is used for making $UO_2$ pellets while building 240 is used for recycle/recovery operations, incineration, waste evaporation and quality control. The covered storage area (Figure 3.3) is used for holding of packaged waste materials awaiting shipment. Other buildings are support and not involved with the processing of uranium.

Effluents

Effluents from the various processes occur in three forms: gaseous, liquid and solids. The effluents contain small quantities of the radioisotopes U-234, U-235, U-236 and U-238. The composition of the mixture will vary depending upon the enrichment of the material being processed; however, in all cases, the bulk of the material will be U-238 (95% by weight or more), whereas the predominant activity will be U-234 (up to 86% of total activity).

Airborne radiological effluents include releases from the Oxide Building as a result of the $UF_6$ to $UO_2$ conversion process, from Building 255 as a result of the $UO_2$ pellet fabrication process, and from Building 240 as a result of cylinder heel wash processing and the oxidation-reduction and pyrohydrolysis processing of recycle material. Figure 3.6 shows the exhaust stack locations. There are three release points of airborne radioactive materials from the Oxide Building. Offgases from the $UF_6$ to $UO_2F_2$ conversion process pass through two sets of porous material filters and are then routed through dry scrubbers. The dry scrubbers contain limestone

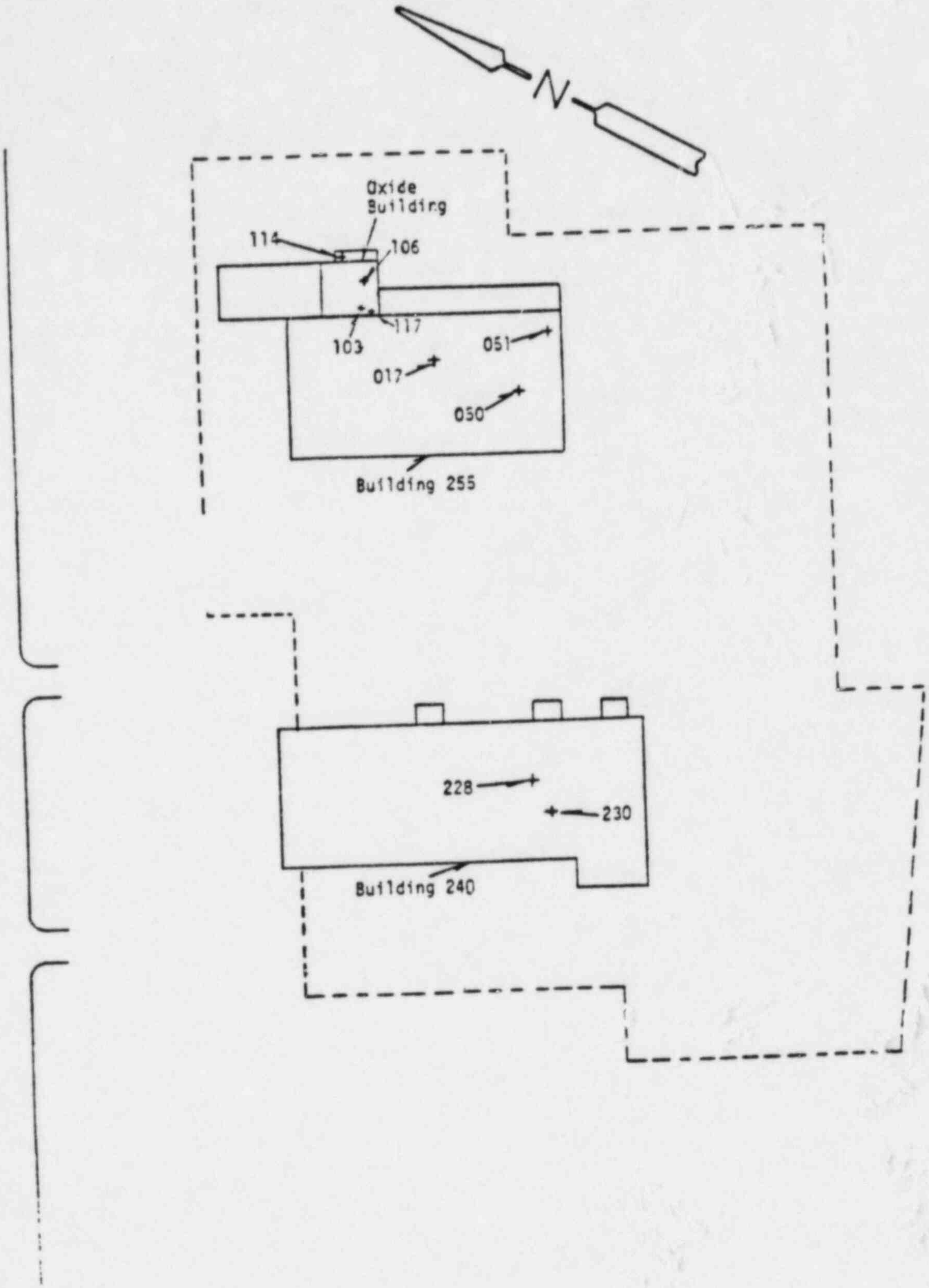


Figure 3.6 Exhaust Stack Locations at the CE Plant

which reacts with the hydrofluoric acid in the filtered offgases to form calcium fluoride.

Process ventilation air from the Oxide Building is passed through single absolute filters (99.97% efficient for removal of 0.3 micron particles) and is vented through the exhaust stacks to the atmosphere. Continuous sampling is provided for each exhaust stack.

Process ventilation air from the Pellet Plant, Building 255, is exhausted through two manifold systems which were installed in May 1975. These systems consolidated 15 former individual exhaust stacks. Each system contains two banks of absolute filters and two banks of prefilters. The prefilters, located upstream from the final ventilation equipment, preserve the effectiveness and longevity of the final filters in the consolidated exhaust systems. The final filters are equipped with pressure differential measuring devices to determine filter loadings. All exhaust points are continuously monitored during operations.

Ventilation air from the cylinder heel processing equipment in Building 240 is exhausted through a single absolute filter and is continuously sampled. The offgases from oxidation-reduction and pyrohydrolysis operations are scrubbed with a potassium hydroxide solution to remove hydrofluoric acid, routed through a single absolute filter and continuously sampled.

Building stacks which normally exhaust radioactive effluents are equipped with continuous samplers except the exhaust from the laboratory fume hoods which handle wet chemicals and two of the three room air exhausts in the Pellet Plant dewaxing and sintering furnace area. Building stacks also have single or double absolute filters except for the laboratory fume hoods exhaust, the Pellet Plant furnace area, Oxide Building room air exhausts and the Oxide Building offgas exhaust. These exceptions utilize other means of filtration and scrubbing as discussed above.

Airborne non-radioactive chemical effluents arise during $UF_6$ to $UO_2$ conversion, pellet dewaxing, and recycle pyrohydrolysis operations. Gaseous waste stream from these operations are treated as if potentially contaminated with uranium compounds.

Airborne chemical wastes from the $UO_2$ powder production operations in the Oxide Building include hydrofluoric acid, nitrogen, hydrogen, water vapor and carbon dioxide. Offgases are routed through dry scrubbers containing limestone. These scrubbers are 90 to 98 percent efficient in removing fluorides.

Airborne chemical wastes from the oxidation-reduction, pyrohydrolysis, and cylinder heel processing operations in Building 240 include water vapor, hydrofluoric acid, ammonia, nitrogen, and hydrocarbons. Offgases from the reaction furnaces are routed through a wet scrubber, as described above. The only significant airborne effluent from cylinder heel processing is unreacted ammonia from the ammonium diuranate (ADU) precipitation process. This ammonia is diluted with air at the rate of 1600 cubic feet of air per minute and is not monitored because of the resultant low concentration of ammonia.

Radiological liquid effluents which contain trace quantities of uranium are generated in Buildings Nos. 240 and 255 as floor mop water and cleanup water. This water is collected and evaporated in a special hood to recover the uranium.

Other radiological wastes, containing only small quantities of uranium are generated in the laundry, in the cleaning of glassware in the laboratory, and in the sinks and showers in the change room. The laundry and laboratory effluents are discharged into the industrial waste system; the change room liquid effluents are routed to the sanitary waste system. These effluents contain smaller concentrations of radionuclides than the Maximum Permissible Concentration (MPC) values for unrestricted areas.*

Sources of non-radioactive liquid sanitary wastes are toilets, sinks, lavatories and drinking fountains. Sources of non-radioactive liquid chemical wastes are boiler treatment chemicals, laboratory chemicals, and effluent from the regeneration of the demineralized water supply system.

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* 10 CFR 20 Appendix B, Table II Concentrations Limits for Unrestricted Areas.

Industrial water is discharged directly to the site pond via the industrial and storm drain lines. This waste water is essentially unchanged in both physical and chemical quality and receives no cleanup treatment. This effluent contains no solid wastes. The origins of industrial waste waters, including storm drains, are shown in Figure 3.7 along with the routes followed by the drain lines to the site pond. Liquid effluents from the laundry and from cleaning of glassware in the laboratory are discharged into the industrial waste drains. This system also carries equipment cooling water. The storm sewer discharges into the site pond which overflows to form the site creek. The overflow is continuously sampled and analyzed for gross alpha and beta activity. The site creek discharges into Joachim Creek at the southern site boundary. Joachim Creek ultimately discharges into the Mississippi River.

The average volume of the industrial waste water effluent generated is about 64,000 gpd. This discharge is identified as No. 002 in the NPDES Permit.

Solid radiological wastes which exhibit detectable contamination consist mostly of rags, papers, packaging materials, worn-out shop clothing, and other miscellaneous materials that are generated in plant operations. These are packaged in 55-gallon drums or 644-cubic foot plastic-lined wooden crates for disposal at a licensed low-level burial site. Waste packages contain less than 25 uCi of activity according to monitored measurements.

Gamma-contaminated solid wastes are placed in sealed 55-gallon steel drums for licensed burial. Bulky items with only low levels of surface contamination are placed in plastic-lined wooden boxes.

A gas-fired incinerator has been added to the plant to reduce the volume of combustible contaminated wastes for shipment to licensed burial. This incinerator supplements the oxidation/reduction furnaces used to reduce wastes which contain recoverable quantities of uranium. The incinerator is equipped with a wet scrubber to clean offgas exhaust prior to routing to the wet recovery stack.

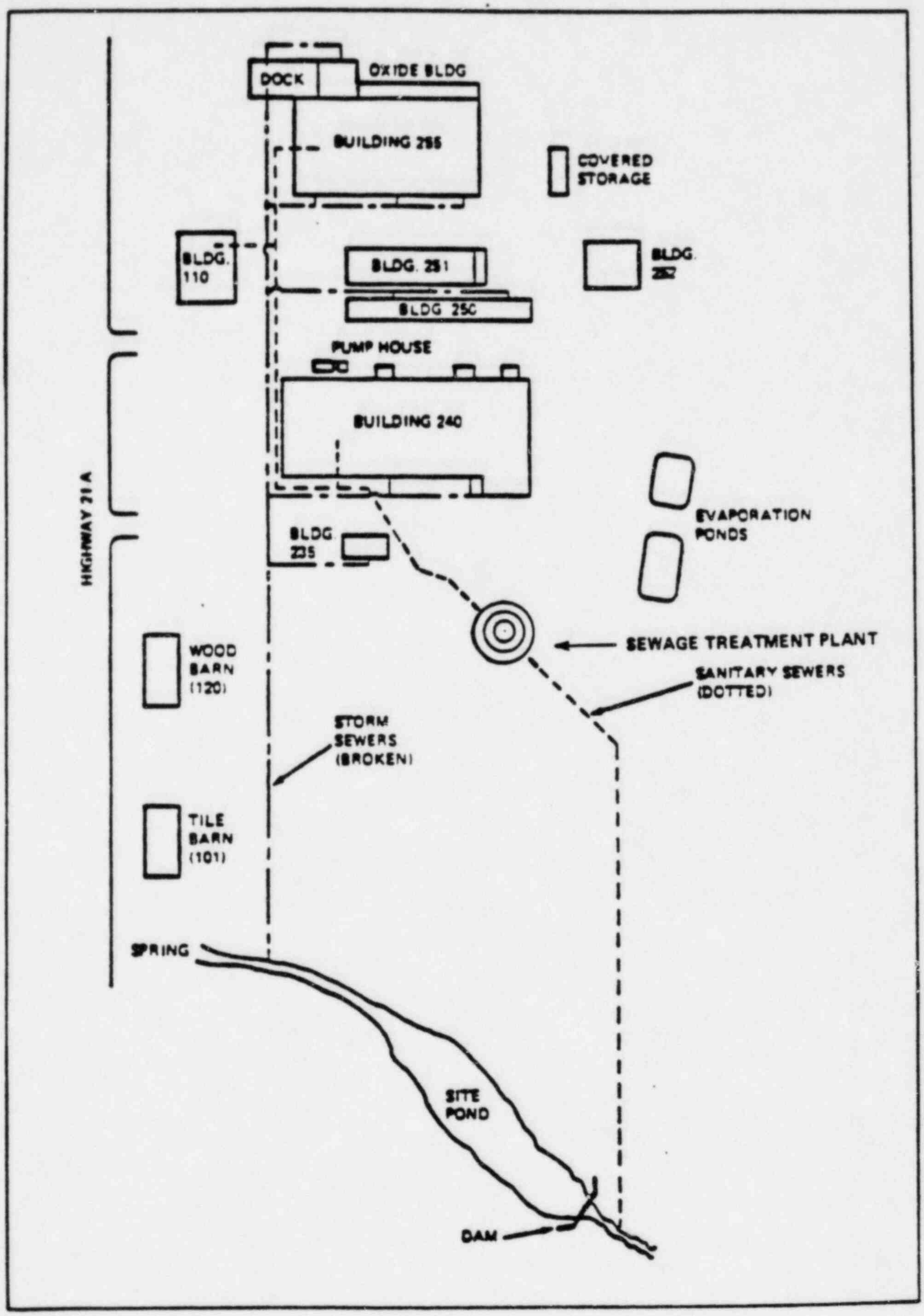


Figure 3.7 Sanitary and Industrial Waste Line Flows

Calcium fluoride and limestone from the plant's dry scrubbers in the process vessel ventilation system may also contain radioactivity. These spent materials, exhibiting barely detectable activity levels, are stored as fill material in the southern and southeastern portions of the fenced manufacturing area. Current operations produce approximately 100 cubic yards of such materials per year. The maximum activity of this stored material does not exceed 50 disintegrations per minute per gram (dpm/gm) which is less than would be found in the majority of natural ores.

The bulk of the non-radioactive solid waste is collected and disposed of by a commercial waste disposal firm. Old items of noncontaminated equipment may be disposed of to commercial scrap dealers.

Effluents from the various operations are treated to reduce chemical, radiological and particulate releases. A summary table showing treatments applied to the various operations is presented in Table 3.2. This table summarizes information contained in the environmental impact appraisal of 1977 and various documents prepared by CE for the NRC[14,15]. The table shows that the uranium is removed by one or more stages of filtration from all the normal ventilation stacks and that most liquid streams likely contaminated with uranium are evaporated so that the uranium can be recovered or disposed of as solid waste. The exception to this is the laundry waste water which has a significant volume but is filtered to limit uranium discharges. The table also shows that the major non-radioactive pollutant (HF) is reduced by the use of dry scrubbers.

Effluents of non-radioactive liquid sanitary wastes are from toilets, sinks, lavatories and drinking fountains. This sanitary waste (No. 001 in the National Pollution Discharge Elimination System (NPDES) Permit) is routed to the new extended aeration sewage treatment plant. The sewage treatment plant is equipped with a hypo-chlorinator and chlorine contact tank which results in a sanitary effluent meeting the final NPDES Permit limitations.

Environmental Monitoring Program

The effluents are monitored by existing CE monitoring programs which focus on uranium and fluoride releases. Table 3.3 describes the

## Table 3.2 Effluent Treatment

| Operation | Gaseous | | Liquid | | Solid | |
|---|---|---|---|---|---|---|
| | Effluent | Treatment | Effluent | Treatment | Effluent | Treatment |
| Ox.de Building | ventilation air | single absolute filter | cleanup/mop water | evaporated | general trash | incinerate if * contaminated |
| Building 255 | ventilation air | 2 prefilters and 2 absolute filters | cleanup/mop water | evaporated | general trash | incinerate if contaminated |
| Building 240 | ventilation air | single absolute filter | cleanup/mop water | evaporated | general trash | incinerate if contaminated |
| Regeneration of Demineralizer Resin | | | NaOH<br>KOH<br>$H_2SO_4$ | discharged to site pond | general trash | commercial waste disposal |
| Quality Control Labs | various fumes | - | wash water | evaporated | general trash | incinerate if contaminated |
| Site Laundry | - | - | wash water | filtered and routed to the site pond | general trash | incinerate if contaminated |
| Boiler Steam Treatment | - | | waste chemicals | discharged to site pond | general trash | commercial waste disposal |

Table 3.2 (continued) Effluent Treatment

| Operation | Gaseous | | Liquid | | Solid | |
|---|---|---|---|---|---|---|
| | Effluent | Treatment | Effluent | Treatment | Effluent | Treatment |
| $UF_6$ to $UO_2$ reduction process (Oxide Building) | $UO_2$ particulates<br>HF vapor<br>$N_2$<br>$H_2$<br>$H_2O$ vapor | double porous metal filters<br>scrubber<br>-<br>-<br>- | Cooling Water<br>Steam Condensate | discharged to site pond because it contains no waste material | Limestone with $CaF_2$ | Onsite disposal |
| $UO_2$ pellet making process (Bldg 255) | $UO_2$ particles<br>trichloroethylene vapors<br>$CO_2$<br>$H_2O$ vapors<br>hydrocarbon vapors | double porous metal filters<br>-<br>-<br>-<br>- | Cooling Water<br>Steam Condensate | water evaporated in in filtered hood<br>discharged to site pond | | |
| $UO_2$ pellet and powder Recycle (Bldg 240) | $UO_2$ particles<br>HF<br>$H_2O$ vapors<br>$N_2$<br>hydrocarbon vapors<br>$NH_3$ | scrubber and single absolute filter<br>scrubber<br>-<br>-<br>-<br>- | Cooling Water<br>Scrubber Solution | discharged to site pond<br>evaporated to dryness | | |
| $UF_6$ cylinder heel recovery (Bldg 240) | ADU particles<br>$NH_3$ | single absolute filter<br>- | filtrate | evaporated to dryness | Lime | packed for licensed burial |

* Incinerator ash is tested for uranium content and if the content is sufficiently high it is processed to recover the uranium. Otherwise, it is packaged for licensed burial.

## Table 3.3 Environmental Monitoring Program

### OPERATIONAL EFFLUENTS MONITORING PROGRAM

| Sample Medium | No. of Sampling Points | Collection & Analysis Frequency | Sample Type | Type of Analysis | Action Level |
|---|---|---|---|---|---|
| Air Effluent | 8 Exhaust Stacks | Continuous & analyze weekly | Particulate | Gross alpha | Two week average MPC |
| Air Effluent | Conversion offgas stack | Continuous & analyze weekly | Particulate | Fluoride | |
| Liquid Effluent | Site dam<br>Sewage treatment outfall | Continuous & analyze weekly | Composite | Gross alpha & beta | Above MPC |
| Solid Waste | Limestone disposed onsite<br>Waste in 55-gal. drums (<25 uCi/package) to licensed burial ground | | | | |

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### OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM

| Sample Medium | No. of Sampling Points | Collection & Analysis Frequency | Sample Type | Type of Analysis |
|---|---|---|---|---|
| Air | 2 onsite remote | Continuous & analyze quarterly | Particulate | Gross alpha |
| Surface Water | Joachim Creek above and below site creek outfall. | Monthly | Grab | Gross alpha & beta |
| | Joachim and site creek confluence | Quarterly | Grab | Gross alpha & beta |
| Ground Water | Plant well | Monthly | Grab | Gross alpha & beta |
| | Offsite well (Hematite) | Quarterly | Grab | Gross alpha & beta |
| | 3 monitoring wells for evaporation ponds | Monthly | Grab | Gross alpha & beta |
| Soil | 4 locations surrounding plant | Quarterly | Grab | Gross alpha & beta |
| Vegetation | 4 locations surrounding plant | Quarterly | Grab | Gross alpha & beta |
| | 4 locations surrounding plant | Quarterly | Fluoride | |

monitoring program. The monitoring occurs at the points of discharge, at various locations on the CE property and at offsite locations. The stacks which are the sources of discharge and are therefore monitored are shown in Figure 3.6. The other monitoring sites, which monitor liquid discharges and the dispersion of the gaseous effluents, are shown in Figure 3.8.

### 3.2.3 Historical Effluents

As discussed in the previous section, the major releases from the Hematite facility are uranium and fluoride. These effluents have been measured and the results of monitoring since 1975 are presented and analyzed in this section. The uranium releases will be addressed first and this followed by a discussion of fluoride releases. This section also discusses a problem which involves technetium-99.

Uranium is released to both the atmosphere and the site pond. The releases to the atmosphere have been measured at the stack and the results are summarized in Table 3.4. Although the seven year average release rate has been 217 uCi/year there was a sharp decrease in annual emissions for the years of 1979 and 1980. These aberrations were due to various ventilation system improvements, lower throughput and shutdown of pelletizing operations. Pellet production was resumed in mid-1981 and emissions have returned to levels more typical of the pre-1979 years' operations.

Uranium air concentrations are measured at two points away from the plant. Table 3.5 shows the accumulated results of this monitoring activity. The north station is located about 140 meters northwest of the plant stack and the southwest station is located about 335 meters southwest of the plant stack. The four year average of this monitoring shows less than $3.7 \times 10^{-15}$ uCi/ml. for the north sampling station and less than $3.3 \times 10^{-15}$ uCi/ml for the southwest monitoring station. The values shown in Table 3.5 appear to be relatively constant, and show no correlation between the release rate and the measured environmental concentrations. The reason could be the gross alpha analysis is not sensitive for concentrations at this level. Accordingly, the staff will require the licensee to composite the gaseous environmental samples collected at each location and analyze

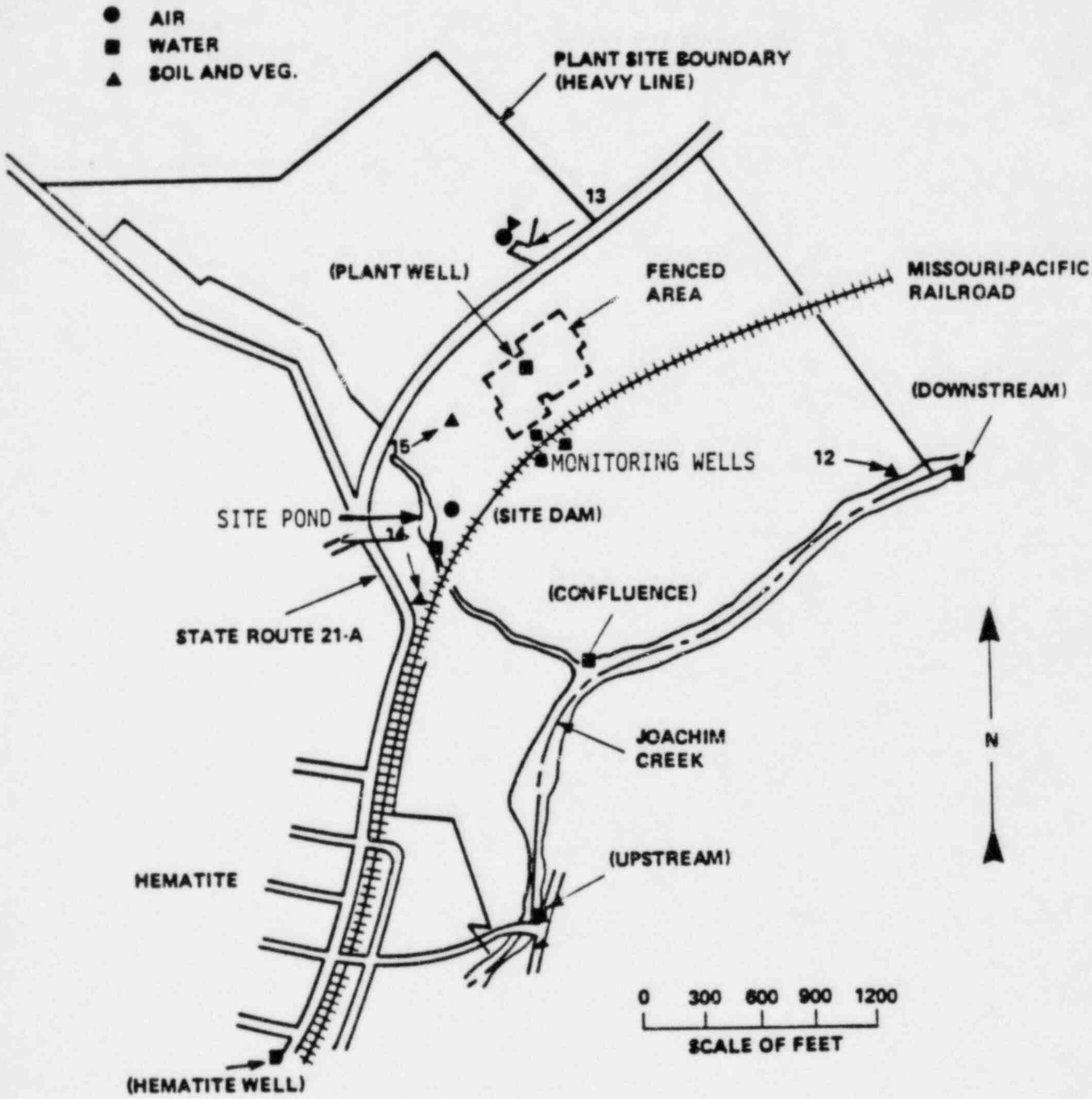


Figure 3.8 Location of Monitoring Sites Around Hematite Facility

Table 3.4 Uranium Releases from the CE Fuel Plant (microcuries)

| MONTH/YEAR | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|
| Jan | 94.9 | 39.4 | 26.9 | 5.9 | 2.0 | 12.9 | 4.5 |
| Feb | 27.7 | 100.7 | 23.7 | 28.4 | 2.2 | 3.2 | 5.5 |
| Mar | 2.9 | 43.8 | 9.3 | 22.0 | 0.8 | 4.9 | 3.6 |
| Apr | 5.8 | 102.7 | 6.2 | 17.6 | 0.7 | 1.6 | 4.0 |
| May | 17.5 | 27.4 | 20.6 | 63.2 | 0.8 | 3.4 | 6.2 |
| Jun | 7.3 | 80.0 | 7.4 | 10.3 | 0.1 | 2.3 | 8.8 |
| Jul | 4.4 | 140.2 | 6.3 | 16.7 | 0.3 | 7.6 | 5.8 |
| Aug | 2.9 | 2.9 | 6.3 | 16.7 | 0.1 | 3.7 | 11.2 |
| Sep | 1.5 | 43.8 | 4.7 | 8.3 | 0.1 | 1.7 | 18.6 |
| Oct | 62.8 | 33.6 | 20.5 | 5.6 | 2.0 | 6.1 | 57.2 |
| Nov | 16.1 | 24.8 | 14.2 | 2.2 | 8.4 | 2.4 | 24.0 |
| Dec | 16.1 | 36.5 | 4.6 | 1.1 | 2.3 | 3.9 | 14.1 |
| Total: | 259.9 | 675.8 | 150.7 | 198.5 | 19.8 | 53.7 | 163.5 |

Table 3.5 Airborne Uranium Monitoring Around the CE Fuel Plant ($10^{-15}$ microcuries per milliliter)

| | 1978 | | 1979 | | 1980 | | 1981 | |
|---|---|---|---|---|---|---|---|---|
| | NORTH STATION | SOUTHWEST STATION | NORTH STATION | SOUTHWEST STATION | NORTH STATION | SOUTHWEST STATION | NORTH STATION | SOUTHWEST STATION |
| Jan | 5 | <2 | <2 | <2 | 5 | 7 | 3 | 3 |
| Feb | <2 | <2 | <2 | 2 | 5 | <2 | 3 | 3 |
| Mar | <2 | <2 | 3 | 9 | 4 | 4 | 5 | 4 |
| Apr | 6 | 3 | <2 | 4 | 7 | <2 | 3 | 4 |
| May | 4 | 3 | 3 | <2 | 3 | 6 | 10 | 13 |
| Jun | 2 | <2 | 4 | <2 | 3 | 2 | 4 | 6 |
| Jul | 2 | 3 | 10 | 2 | 5 | <2 | 3 | 3 |
| Aug | 6 | 4 | 6 | 3 | 3 | 3 | 2 | 7 |
| Sep | 4 | 2 | 5 | 3 | 3 | <2 | 3 | 4 |
| Oct | 5 | 7 | 2 | <2 | 4 | <2 | 4 | 6 |
| Nov | 6 | 6 | 3 | 3 | 7 | 4 | 4 | 5 |
| Dec | 2 | <2 | 3 | 4 | 3 | 6 | 3 | 3 |
| Average Concentration | 3.8 | 2.8 | 3.2 | 2.5 | 3.9 | 2.7 | 3.9 | 5.0 |

them for uranium on a quarterly basis. The analytical technique used shall provide a sensitivity of at least $10^{-16}$ uCi/ml.

Uranium discharges to the water can be estimated by examining the monitoring data from the site dam overflow and from the sewage outfall. Table 3.6 shows the results of site dam overflow monitoring for the years 1975 through 1981. The table shows that activity levels were relatively constant throughout the period with the exception of the technetium-99 beta activity which was detected in August of 1978. The average alpha level was 62 pCi/1, and the average beta activity level was 88 pCi/1. Using a conversion factor of 2.38 uCi alpha/gram uranium and a flow rate of $7.7 \times 10^8$ liters/year, it can be estimated that the annual discharge rate is 20,000 grams/year. In addition to the gross alpha and beta analysis, the staff requires that the licensee composite representative water samples and analyze for Tc-99 on a semi-annual basis.

Sanitary waste has also been measured and the results are reported in Table 3.7. The table shows that average sewage alpha activity levels have been about 113 pCi/l. When this concentration is multiplied by the sanitary water flow rate ($1.9 \times 10^6$ liters/year) and it is assumed that all the alpha activity is due to uranium, discharge rate for uranium can be estimated. Doing the appropriate multiplication and unit conversion, the average amount of uranium discharged via the sanitary waste water is about 90 grams.

An overall uranium balance for liquid discharges can be made by comparing predicted and actual alpha activity levels in Joachim Creek upstream and downstream of the Hematite plant. Table 3.8 presents the results of the environmental monitoring effort for both alpha and beta activity.

Fluoride is the major non-radiological release associated with plant operation. The major point of release, the process stack for the Oxide Building is sampled on a continuous basis. The results of this monitoring are presented in Table 3.9. The table shows that the annual release of fluoride is around 5,600 kg. Measurements of the fluoride level of the vegetation at the site perimeter are also taken. The results of this monitoring is shown in Table 3.10. Station 12 is about 540 meters East-

Table 3.6 Uranium Monitoring Data for the Site Dam Overflow at the CE Plant (picocuries per liter)

| MONTH/YEAR | 1975 | | 1976 | | 1977 | | 1978 | | 1979 | | 1980 | | 1981 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| Jan | 85 | 53 | 52 | 18 | 59 | 50 | 74 | 14 | 231 | 124 | 26 | 16 | 52 | 16 |
| Feb | 18 | 10 | 107 | 60 | 34 | 17 | 61 | 122 | 12 | 18 | 20 | 27 | 34 | 34 |
| Mar | 34 | 21 | 160 | 50 | 14 | 14 | 16 | 13 | 8 | 8 | 17 | 10 | 16 | 11 |
| Apr | 12 | 15 | 228 | 65 | 27 | 15 | 10 | 17 | 16 | 11 | 21 | 49 | 54 | 65 |
| May | 22 | 32 | 73 | 26 | 28 | 25 | 10 | 13 | 16 | 36 | 29 | 26 | 9 | 7 |
| Jun | 111 | 90 | 81 | 56 | 78 | 30 | 65 | 67 | 61 | 66 | 47 | 40 | 5 | 7 |
| Jul | 103 | 180 | 83 | 25 | * | * | 45 | 628 | 63 | 79 | 67 | 84 | 9 | 11 |
| Aug | 65 | 22 | 235 | 47 | 158 | 56 | 128 | 2,374 | 38 | 31 | 39 | 45 | 8 | 11 |
| Sep | 28 | 16 | 187 | 45 | 173 | 114 | 93 | 654 | 38 | 29 | 23 | 14 | 9 | 19 |
| Oct | 89 | 36 | 153 | 45 | 76 | 59 | 220 | 429 | 71 | 96 | 82 | 26 | 9 | 9 |
| Nov | 102 | 32 | 82 | 39 | 31 | 16 | 138 | 276 | 48 | 77 | 26 | 17 | 8 | 7 |
| Dec | * | * | 144 | 74 | 16 | 18 | 63 | 84 | 29 | 17 | 16 | 8 | <2 | 3 |
| Avg. Conc.: | 61 | .46 | 132 | 46 | 63 | 38 | 77 | 391 | 53 | 49 | 34 | 30 | 17 | 16 |
| % MPC: | 0.2 | 0.2 | 0.4 | 0.2 | 0.2 | 0.1 | 0.3 | 2.0 | 0.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 |

* Data no^ available

NOTE: Beta activity for August 1978 identified as Technicium 99, having MPC of 3 x $10^5$ ρCi/ml. Percent MPC however, is based on an MPC of 20,000 ρCi/ ·

Table 3.7 Uranium Monitoring Data for the Sanitary Waste Water at the CE Plant (picocuries per liter)

| MONTH/YEAR | 1977[1] | | 1978[2] | | 1979 | | 1980 | | 1981 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| January | | | 261 | 75 | 493 | 139 | 83 | 38 | 8 | 20 |
| February | 40 | 16 | 669 | 166 | 133 | 68 | 301 | 78 | 24 | 60 |
| March | | | 105 | 36 | 118 | 95 | 126 | 150 | 16 | 39 |
| April | | | 80 | 57 | 53 | 138 | 34 | 42 | 262 | 299 |
| May | [3] | [3] | 116 | 354 | 53 | 61 | 35 | 47 | 66 | 274 |
| June | | | 95 | 120 | 47 | 70 | 8 | 67 | 28 | 362 |
| July | | | 89 | 191 | 66 | 33 | 54 | 361 | 61 | 206 |
| August | 385 | 133 | 149 | 114 | 69 | 66 | 62 | 367 | 11 | 129 |
| September | | | 51 | 121 | 40 | 29 | 72 | 226 | 17 | 176 |
| October | | | 70 | 67 | 53 | 35 | 209 | 119 | 35 | 114 |
| November | 44 | 22 | 90 | 174 | 78 | 84 | 170 | 45 | 21 | 59 |
| December | | | 147 | 89 | 50 | 33 | 19 | 37 | 22 | 74 |

[1] Quarterly sampling was conducted during 1977

[2] New sewage treatment plant installed May 1978

[3] No sample due to intermittent trickle discharge

Table 3.8 Uranium Monitoring Data on Joachim Creek near the CE Plant (picocuries per liter)

*Data not available

**Stream frozen over - no sample collected

| MONTH/YEAR | 1975 | | | | 1976 | | | | 1977 | | | | 1978 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | | Downstream | | Upstream | | Downstream | | Upstream | | Downstream | | Upstream | | Downstream | |
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| January | <2 | 8 | <2 | <1 | <2 | 4 | 8 | 4 | ** | ** | ** | ** | ** | ** | ** | ** |
| February | * | * | * | * | <2 | <1 | 6 | <1 | 5 | 3 | 3 | <3 | 2 | 3 | 3 | 3 |
| March | * | * | * | * | <2 | <1 | <2 | 5 | 4 | 6 | 2 | 5 | 3 | 7 | <2 | 2 |
| April | <2 | <1 | 28 | <1 | 6 | <1 | 8 | <1 | 2 | 3 | 3 | 9 | 2 | 2 | 3 | 3 |
| May | * | * | * | * | <2 | 5 | <2 | <1 | 2 | 3 | 3 | 2 | 2 | 4 | <2 | 3 |
| June | <2 | <1 | <2 | 5 | <2 | <1 | <2 | 5 | <2 | 5 | 4 | 4 | 2 | 3 | 5 | 5 |
| July | 6 | 12 | <2 | 5 | <2 | <1 | <2 | <1 | 2 | 9 | 5 | 5 | 3 | 4 | 14 | 17 |
| August | * | * | * | * | 4 | 4 | 5 | 4 | 2 | 12 | 18 | 12 | <2 | 3 | <2 | 23 |
| September | <2 | <1 | <2 | <1 | <2 | 2 | 6 | 3 | 6 | 11 | 7 | 7 | <3 | 4 | 4 | 9 |
| October | <2 | 21 | 4 | 10 | <2 | 4 | 5 | 8 | 2 | 60 | 2 | 5 | <2 | 4 | 4 | 7 |
| November | <2 | <1 | <2 | <1 | 7 | 5 | 10 | 9 | <2 | 3 | <2 | 3 | 6 | <3 | <2 | <3 |
| December | * | * | * | * | <2 | 5 | 13 | 6 | <2 | 4 | 2 | 4 | 2 | 9 | 2 | 5 |

| | 1979 | | | | 1980 | | | | 1981 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | | Downstream | | Upstream | | Downstream | | Upstream | | Downstream | |
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| January | ** | ** | ** | ** | 4 | 5 | 5 | 3 | ** | ** | ** | ** |
| February | <2 | 3 | <2 | 6 | 3 | <3 | <2 | <3 | <2 | <3 | <2 | <3 |
| March | <2 | <3 | <2 | 4 | <2 | 6 | <2 | 4 | <2 | 4 | <2 | 3 |
| April | <2 | 3 | <2 | 3 | 4 | <3 | 7 | 5 | 36 | 9 | <2 | 7 |
| May | <2 | 4 | 3 | 5 | 7 | 3 | 3 | 4 | 5 | 6 | <2 | 5 |
| June | <2 | <3 | <2 | 4 | 3 | 3 | 3 | 4 | 5 | 5 | 4 | 2 |
| July | <2 | 4 | 2 | 3 | <2 | <3 | <2 | <3 | 59 | 37 | <2 | <3 |
| August | 8 | 9 | 5 | 3 | 3 | 3 | 6 | 3 | <2 | <3 | <2 | <3 |
| September | <2 | 7 | 2 | 6 | <2 | <3 | <2 | <3 | <2 | <3 | <2 | <5 |
| October | 4 | 8 | 9 | 4 | <2 | 3 | <2 | <3 | <2 | <3 | <2 | 5 |
| November | 1 | 3 | 5 | 5 | <2 | <3 | 4 | 3 | <2 | 3 | <2 | <3 |
| December | <2 | 5 | 1 | 6 | <2 | <3 | <2 | <3 | <2 | <3 | <2 | 6 |

Table 3.9 Fluoride Releases from the CE Plant
($10^3$ pounds F° released)

| MONTH/YEAR | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|
| January | - | 1.0 | 0.6 | 1.2 | 1.4 |
| February | - | 0.6 | 1.5 | 2.4 | 0.8 |
| March | - | 0.5 | 0.7 | 1.4 | 2.0 |
| April | 0.5 | 1.2 | 1.2 | 1.1 | 0.9 |
| May | 0.9 | 1.1 | 1.6 | 2.6 | 1.8 |
| June | 1.1 | 1.1 | 0.1 | 2.1 | 1.5 |
| July | 0.3 | 0.9 | 1.0 | 0.3 | 0.1 |
| August | 1.1 | 0.7 | 1.7 | 1.2 | 1.7 |
| September | 0.2 | 1.5 | 1.5 | 0.7 | 0.9 |
| October | 0.8 | 1.0 | 2.0 | 0.4 | 0.8 |
| November | 0.7 | 0.4 | 0.9 | 1.7 | 0.8 |
| December | 0.3 | 0.6 | 1.3 | 0.1 | 1.0 |
| Total | 5.9 (9 mo.) | 10.6 | 14.1 | 15.2 | 13.7 |

Table 3.10 Vegetation Monitoring for Fluoride at the CE Plant
(parts per million)

| | DATE | STATION 12 | STATION 13 | STATION 14 | STATION 15 |
|---|---|---|---|---|---|
| 1976 | Jul | <2.0 | <2.0 | <2.0 | 2.0 |
| | Nov | [2] | [2] | [2] | [2] |
| 1977 | Mar | 12.4 | 12.4 | 22.8 | 29.0 |
| | Jun | 3.2 | 2.4 | <2.0 | <2.0 |
| | Sep | 4.2 | <2.0 | 3.4 | <2.0 |
| | Oct | 3.8 | 2.1 | 2.0 | 1.5 |
| 1978 | Mar | 92.0 | 22.0 | 17.0 | 15.0 |
| | Jun | 28.4 | 16.0 | 11.7 | 25.2 |
| | Sep | 4.6 | 6.4 | 3.0 | 7.4 |
| | Nov | 4.0 | 8.2 | <2.0 | 2.6 |
| 1979 | Mar | 66.0 | 23.0 | 16.0 | 25.0 |
| | May | 21.0 | 8.0 | 7.0 | 19.0 |
| | Aug | 9.0 | 8.0 | 9.0 | 9.0 |
| | Nov | 11.0 | 56.0 | 10.0 | 18.0 |
| 1980 | Mar | 6.0 | 18.0 | 9.0 | 19.0 |
| | Jun | 4.6 | 24.0 | <4.0 | 7.6 |
| | Sep | 26.0 | 8.6 | 9.2 | 15.2 |
| | Nov | <2.0 | <2.0 | <2.0 | 12.0 |
| 1981 | Mar | 16.0 | 18.0 | 11.0 | 43.0 |
| | Jun | 19.0 | 9.0 | 3.0 | 5.0 |
| | Sep | 21.0 | 11.0 | 15.0 | 7.0 |
| | Nov | <5.0 | 23.0 | <5.0 | 12.0 |

[1]Total fluoride in sample as collected

[2]Data not available

southeast of the plant stack while Station 13 is about 140 meters Northwest, Station 14 is about 470 meters South-southwest and Station 15 is about 245 meters Southwest. The fluoride concentrations presented in this Table can be used as a check on the emissions presented in Table 3.9. This check was made using 1) the relationship that an ambient air concentration of 0.5 $ug/m^3$ results in a vegetation fluoride concentration of 40 ppm[16] and 2) the Chi/Q values presented in Table 3.1. The measured plant fluoride concentrations are all about a factor of 10 lower than predicted. Given the uncertainty in meteorology and fluoride uptake factor this comparison is considered very satisfactory.

Fluoride is also measured at the Hematite site dam overflow. The results of this monitoring are presented in Table 3.11. The table shows that fluoride levels are low (less than 1.2 mg/l) and rather consistent at this level. The total amount of fluoride released over the site dam is about 1,300 kg/year. The concentrations are below the limits specified in the NPDES discharge permit.

The normal radiation monitoring programs conducted at the Hematite facility detected a potential environmental problem involving uranium cylinders which are occasionally washed to recover residual uranium. The wash solution was monitored for beta activity and was found to contain technetium-99 which had been introduced as a containment into the gaseous diffusion plants. This material was processed through an ion exchange column to remove the majority of the technetium. The liquid, after ion exchange treatment, was transferred to the onsite evaporation ponds, as were other plant waste streams, resulting in some accumulation of uranium, uranium daughters and technetium. Monitoring wells were drilled between the ponds and Joachim Creek in order to monitor for groundwater contamination. The results of the monitoring program are shown in Table 3.12. In September 1978, the use of the onsite evaporation ponds was discontinued, and liquid waste streams formerly discarded to the ponds were evaporated to dryness and the residue disposed of as solid waste.

In order to characterize the environmental implications of the technetium contamination in the groundwater, the results of the monitoring well sampling program and the pond sampling progam have

Table 3.11 Fluoride Monitoring at the CE Plant Dam Overflow (milligrams per liter)

| MONTH/YEAR | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|
| January | * | * | 2.5 | * | <1.0 | 5.0 | * |
| February | * | <1.0 | <1.0 | <1.0 | <1.0 | 1.0 | <1.0 |
| March | * | * | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| April | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 2.0 | <1.0 |
| May | * | <1.0 | <1.0 | <1.0 | <1.0 | 8.0 | <1.0 |
| June | * | <1.0 | <1.0 | <1.0 | <1.0 | 17.0 | <1.0 |
| July | * | <1.0 | * | 1.6 | <1.0 | <1.0 | <1.0 |
| August | * | <1.0 | 1.6 | 1.9 | <1.0 | <1.0 | <1.0 |
| September | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| October | * | <1.0 | <1.0 | <1.0 | 9.0 | <1.0 | <1.0 |
| November | 3.0 | 2.4 | <1.0 | 2.0 | <1.0 | <1.0 | <1.0 |
| December | * | 2.5 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |

* not analyzed

Table 3.12 Technetium Monitoring in the Wells Associated with the Evaporation Ponds at the CE Plant (picocuries per liter)

| MONTH/YEAR | 1977 | | | | | | 1978 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | North | | East | | West | | North | | East | | West | |
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| January | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| February | 33 | 105 | 41 | 24 | * | * | 3 | 65 | 2 | 212 | * | * |
| March | 12 | 13 | 6 | 5 | * | * | 2 | 217 | <2 | 3 | * | * |
| April | <2 | 58 | <2 | <3 | * | * | 5 | 120 | 3 | 6 | * | * |
| May | 8 | 134 | 6 | 3 | * | * | 7 | 611 | <2 | <3 | * | * |
| June | 5 | 596 | 2 | 4 | * | * | 9 | 447 | 9 | 9 | * | * |
| July | 6 | 460 | 12 | 9 | * | * | 4 | 1,550 | <2 | 4 | * | * |
| August | 8 | 1,510 | 5 | 18 | * | * | 54 | 4,820 | 10 | 12 | * | * |
| September | 28 | 937 | 5 | 4 | * | * | 86 | 1,030 | 6 | 9 | * | * |
| October | 3 | 8 | 2 | 5 | * | * | 57 | 581 | 4 | 4 | 13 | 12 |
| November | 2 | 107 | <2 | <3 | * | * | 69 | 1,490 | 17 | 13 | 16 | 14 |
| December | 3 | 76 | <2 | 3 | * | * | 8 | 337 | 4 | 7 | 13 | 14 |

| | 1979 | | | | | | 1980 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | North | | East | | West | | North | | East | | West | |
| | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta | alpha | beta |
| January | ** | ** | ** | ** | ** | ** | 48 | <3 | 2 | 5 | 2 | 3 |
| February | 17 | 432 | 2 | 5 | 5 | 7 | 36 | 546 | 3 | 2 | 16 | 8 |
| March | 25 | 566 | <2 | <3 | 5 | 10 | 13 | 386 | <2 | 7 | 2 | 2 |
| April | 12 | 363 | 2 | <3 | 5 | 5 | 17 | 385 | 6 | <3 | 6 | 4 |
| May | 26 | 316 | <2 | 5 | 4 | 12 | <2 | <3 | 3 | 7 | 4 | 4 |
| June | 8 | 270 | 7 | 10 | <2 | 3 | 7 | 12 | 5 | 4 | 3 | <3 |
| July | 23 | 452 | 8 | 18 | 23 | 22 | 31 | 1696 | 2 | <3 | <2 | 5 |
| August | 22 | 520 | 5 | 5 | 9 | 9 | <2 | <3 | 6 | 3 | 7 | 9 |
| September | 30 | 317 | 8 | 9 | 3 | 7 | <2 | 98 | <2 | <3 | <2 | 3 |
| October | 40 | 27 | 3 | 4 | 11 | 7 | <2 | 992 | <2 | <3 | 7 | 10 |
| November | 42 | 1125 | <2 | 16 | 5 | 2 | <2 | 377 | 18 | 6 | 4 | 3 |
| December | 25 | 447 | <2 | 7 | 1 | 9 | <2 | 6 | <2 | 3 | <2 | 5 |

| MONTH/YEAR | 1981 | | | | | |
|---|---|---|---|---|---|---|
| | North | | East | | West | |
| | alpha | beta | alpha | beta | alpha | beta |
| January | ** | ** | ** | ** | ** | ** |
| February | <2 | 61 | <2 | 4 | 5 | 5 |
| March | <2 | 87 | <2 | <3 | <2 | <3 |
| April | 8 | 382 | 5 | 7 | 34 | 22 |
| May | <2 | 755 | <2 | 14 | <2 | 9 |
| June | <2 | 436 | <2 | <3 | <2 | 5 |
| July | <2 | 33 | <2 | <3 | 15 | 19 |
| August | 3 | 596 | <2 | <3 | <2 | 3 |
| September | <2 | 379 | <2 | <3 | <2 | 3 |
| October | 8 | 381 | <2 | <3 | 21 | 14 |
| November | 2 | 346 | <2 | <3 | <2 | 12 |
| December | <2 | 363 | <2 | 3 | <2 | 12 |

* Well dry at this time

** No sample due to heavy ice and snow cover

NOTE: Beta activity in July 1978 north well sample identified as Technicium 99.

been examined. The examination has shown that the west pond contained technetium at a level of about $6x10^{-3}$ uCi/ml in late 1978.[17] Reviews of the chemistry of technetium [18,19] indicate that technetium would not be absorbed to any significant extent while flowing through ground media. The general data suggests that technetium is gradually being drained from the evaporation pond, diluted several orders of magnitude before it reaches the monitoring wells and then is further diluted as it travels toward Joachim Creek. However, the staff considers that the continued seepage of radionuclides from the unused ponds is undesirable. The staff requires that the licensee complete decommissioning of the ponds as soon as reasonably achievable.

### 3.2.4 Expected Annual Releases

The previous section identified the discharges from the Hematite facility. It also provided estimates of the quantities being released or concentrations resulting from release. Since no significant changes in the near future are anticipated for the facility, releases are expected to be very similar to those for past years. Table 3.13 provides a summary of the estimated discharge quantities for air releases and discharge concentrations for aquatic releases.

As has previously been mentioned in Sections 3.1 and 3.2.2, a proposed plan for plant expansion has been developed by Combustion Engineering. Beyond plan development however, no further action has been taken, no time frame has been set for implementation of the expansion plan and an increased demand for nuclear fuel has not materialized. If, however, the expansion were to be implemented, the environmental assessment of that action[20] indicates that while there would be a slight increase in radiological and non-radiological effluents released to the environment the resulting concentrations would remain well below all applicable limits.

## 3.3 ALTERNATIVE ACTION

The proposed action is to grant license renewal without a change in license conditions which would impact facility design or operation. An alternative to license renewal is license denial as briefly described in the following paragraph.

Table 3.13 Expected Release Rates and Concentrations of Materials of Environmental Concern for the Unexpanded CE Plant

| Material Released | Mass Released to the Atmosphere | Concentration Before Discharge into Joachim Creek* |
|---|---|---|
| Uranium | $9.0 \times 10^{1}$ g/yr | $2.6 \times 10^{-5}$ g/l |
| Fluoride | $5.6 \times 10^{6}$ g/yr | $<1.7 \times 10^{-3}$ g/l |

* Annual flow rate estimated to be about $7.7 \times 10^{8}$ liters.

Denial of License Renewal

The alternative action is the denial of license renewal whereby CE would be required to cease operations and begin plant and site decommissioning. The implications of this alternative are discussed in Section 4.2.

## 4.0 AFFECTED ENVIRONMENT

The previous section (3.0) described the proposed action, local environmental characteristics, effects of plant operations and identified a possible alternative action. The purpose of this section is to identify those environmental components (air, water, etc.) which will be affected by the proposed action or the alternative.

### 4.1 AFFECTED ENVIRONMENT OF THE PROPOSED ACTION

This section identifies and discusses those environmental components expected to be affected by the proposed action. They include air quality, ecosystems and water quality, and are discussed in the following paragraphs.

#### 4.1.1 Air Quality

The ambient air quality in the Hematite area, according to the U.S. EPA headquarters in Kansas City, Missouri, is an attainment area for the National Primary and Secondary Air Quality Standards, i.e., it does meet the applicable standards.

A chemical not addressed by those standards but of concern in this analysis is flucride. As discussed in the previous section, the annual release of fluorides from the current facility is estimated to be 5,600 kg/year. While the State of Missouri has no fluoride emission or ambient air standards, standards published by the State of Washington[3] have been used to evaluate plant performance. This source establishes an ambient standard of 0.5 $ug/m^3$. The current CE facility meets this standard for locations greater than about 500 meters from the stack. This in essence means that the Washington State Standard is not exceeded in any residential area.

With respect to radiological releases, monitoring of airborne radioactivity during the past five years calculated at the Combustion Engineering Nuclear Fuel Manufacturing Plant site boundary has disclosed an average radiological gaseous activity level of $0.7 \times 10^{-15}$ uCi/ml.

Consideration of the average radiological gaseous activity and the annual fluoride releases indicates there will be some impact on the quality of the air within the immediate vicinity (500-600 meters) of the CE plant. The degree of impact however, will be minimal because concentrations are below applicable standards.

### 4.1.2 Ecosystem (Vegetation)

Vegetation monitoring stations have, during the past four years, shown average concentrations of fluorides on plants to be below the maximum value of 40 ppm legislated by the State of Washington for forage. Some of the samples, taken during the spring, exceeded this value by 50 to 100%. Although it is identified here that this environmental component will be impacted, the impact is considered to be minimal because 1) the concentration levels in forage beyond the site boundary are below the Washington State recommended standards (40 ppm)[3] and 2) there are no Missouri State Standards for fluoride emissions.

### 4.1.3 Water Quality

The Hematite site has been monitored in order to determine both the background water quality and the effect of plant operation on this water quality. The monitoring program has involved five surface water sampling points.

The program has shown that the most concentrated effluent stream of radioactivity is associated with the sanitary waste water. The dilution of this stream with onsite stream waters and later the Joachim Creek waters results in downstream activity levels which are only slightly above the upstream activity levels.

Water flowing from the onsite pond into the onsite stream has also been monitored for fluoride content. During the past seven years the concentration has averaged less than 1.2 mg/l and is below the National Interim Primary Drinking Water Regulations of 1.8 mg/l and below the NPDES limit of 1.2 mg/l.

## 4.2 AFFECTED ENVIRONMENT OF THE ALTERNATIVE ACTION

If the alternative action (denial of license renewal) is pursued, all normal operating releases to the environment will cease. After decommissioning, there will be no need for natural resources such as water nor will there be any energy requirements. The socioeconomic component would be significantly impacted due to loss of worker employment and loss of revenue by CE.

## 4.3 COMPARISON OF PROPOSED AND ALTERNATIVE ACTIONS

The previous Sections (4.1 and 4.2) identified the environmental components which would be impacted by the proposed and alternative actions. This Section presents a comparison of the two actions. The method of developing the comparison is through the use of a summary table: Table 4.1. This table shows that there are two relatively minor issues (air quality and water quality) and one larger issue (socioeconomic) involved in the choice between the actions. The air and water quality impacts are judged to be minor because the emissions are in compliance with standards and because the doses are small. Section 5.0 presents a quantitative analysis of the doses associated with the proposed action under both normal operating and postulated accident conditions.

Table 4.1 Summary Compariso of Proposed and Alternative Action

| Action | Environment Component | | |
|---|---|---|---|
| | Air Quality | Water Quality | Socioeconomic |
| Proposed Action | Minor negative impact due to fluoride and uranium discharges | Minor negative impact due to fluoride and uranium discharges | Positive impact due the employment of about 60 people |
| Denial | Minor positive impact | Minor positive impact | Negative impact due to the loss of about 60 jobs, the possible need for personnel relocation and economic hardship for CE |

## 5.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

### 5.1 GENERAL DISCUSSION

The purpose of this section is to quantify the environmental impacts caused by the continued operation of Combustion Engineering's nuclear fuel fabrication plant. The areas of impact addressed in this sec on are air quality and water quality which were identified in Section 4.

The assessment addresses two types of impact: radiological and non-radiological. Within each type, impacts caused by routine plant operation and possible accidents were assessed. Normal and accidental releases of uranium were considered in the assessment of radiological impacts. The non-radiological assessment focused on the potential impacts caused by the routine release of fluoride and the possible accidental release of ammonia and fluoride. The assessments were made by comparing estimated consequences to established requirements or recommendations. Title 40, Code of Federal Regulations, Part 190 (40 CFR 190) provided the guidelines for radiological assessment. This regulation limits individual dose for routine operation to 25 mrem/year to the total body, 75 mrem/year to the thyroid, and 25 mrem/year to any other organ. The Washington State fluoride standard[3] was used for assessing fluoride impacts. This standard establishes a limit of 0.5 $ug/m^3$ for ambient air as a level appropriate for the protection of plants and the animals which might eat them.

### 5.2 RADIOLOGICAL ASSESSMENT

The radiological assessment of air releases involved the use of a human exposure model developed at Oak Ridge National Laboratory called AIRDOS II[21]. This model quantifies the dose consequences to population as a result of radiological releases. The significant pathways considered in the assessment include air immersion, inhalation, food ingestion, and direct exposure to soil and water bodies. These potentially significant pathways are illustrated in Figure 5.1.

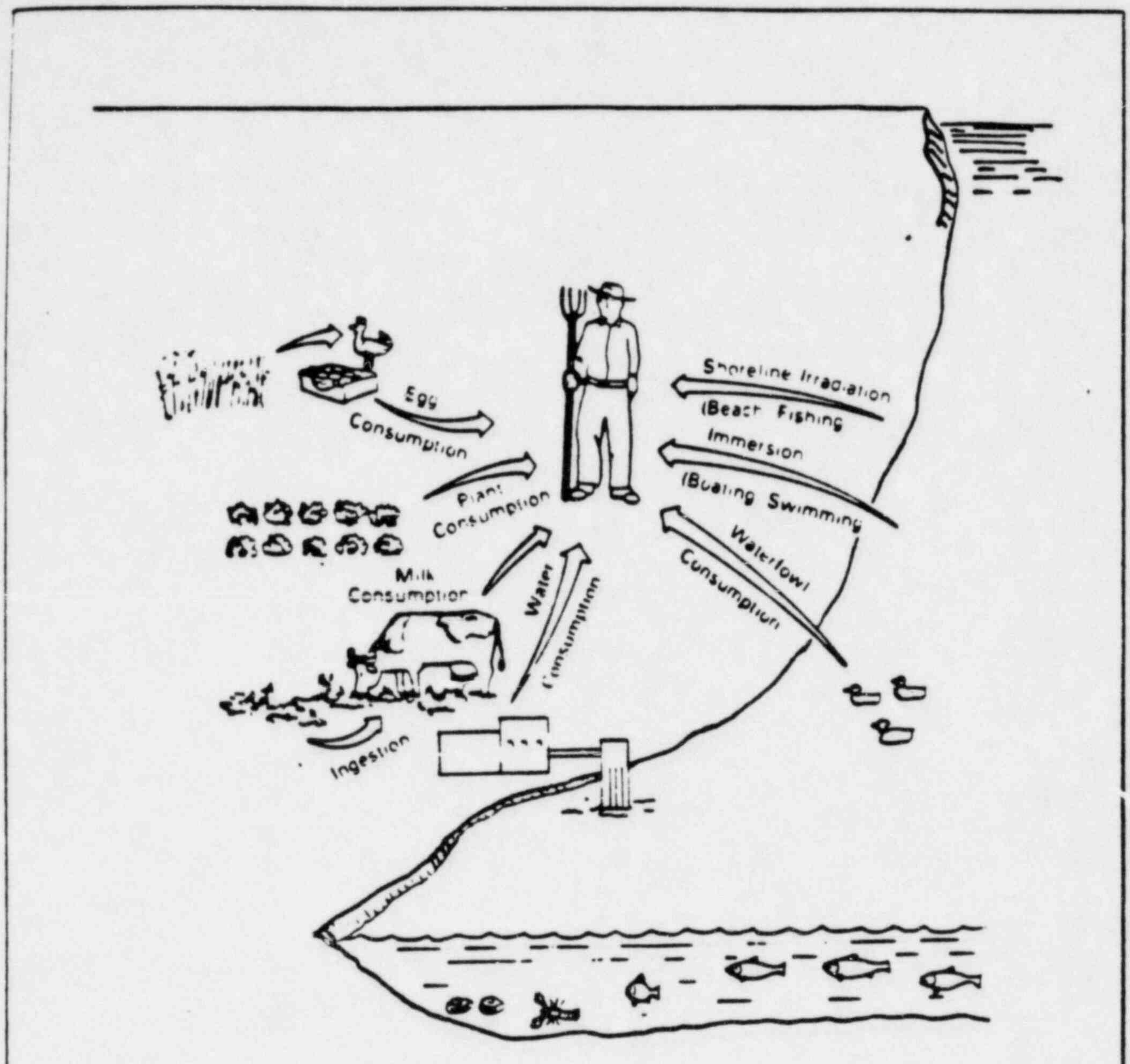


Figure 5.1 Potential Exposure Pathways Through Which People May be Exposed to Radioactive Material

AIRDOS II includes calculations for atmospheric dispersion and envirormental exposure which follow the requirements of United States Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109, "Calculation of annual doses to man from routine releases of reactor effluents for the purpose of evaluating compliance with 10 CFR Part 50, Appendix I," and Guide 1.111, "Methods for estimating atmospheric transport and dispersion of gaseous effluents in routine releases from light-water-cooled reactors."

The radiological assessment of liquid releases was made using models presented in NRC Regulatory Guide 1.109, with the calculations performed by hand rather than by computer.

The radiological impacts were assessed by calculating the maximum dose to the nearest resident who lives about 800 meters (one-half mile) southwest of the plant. The term "dose" for normal releases is actually a 50-year dose commitment, i.e., the total dose to an organ from one year's chronic intake over the remaining lifetime (50 years) of the individual.

### 5.2.1 Routine Plant Operations

During routine plant operations, uranium releases are the radiological source terms that could affect humans. These releases are gaseous and liquid as presented in Table 3.13.

Estimates of the consequences of normal airborne releases were made using the AIRDOS II computer code for air releases. Simpler hand calculations were used for the water releases. These estimates for maximum individual dose commitment are presented in Table 5.1. The critical organ for routine releases is the lung of the nearest resident. It is estimated to receive 0.056 mrem/yr. The limit for maximum individual dose from routine plant operation is specified in 40 CFR Part 190 as 25 mrem/year. This analysis shows that the annual dose to the nearest resident will be below the recommended limits and that there will be no adverse impact to humans due to the routine release of radioactive materials from the plant. The total population out to 50 miles will receive, as a result of air releases, 1.7 person-rem/year.

Table 5.1 Radiological Doses from Routine Operation of CE Hematite Plant

| | Organ | | | | |
|---|---|---|---|---|---|
| Air Effluents | Total Body | Kidney | Bone | G.I. Tract | Lungs |
| Nearest Resident Dose (mrem/year) | 1.4E-4 | 2.1E-4 | 8.0E-4 | 7.0E-5 | 5.6E-2 |
| Total Population Dose (person-mrem/year) | 5.1E+0 | 6.5E+0 | 2.4E+1 | 2.0E+0 | 1.7E+3 |
| <u>Liquid Effluents</u> | | | | | |
| Nearest Resident Dose (mrem/year) | | | | | |
| o from uranium | 9.0E-4 | 3.4E-3 | 1.5E-2 | 1.1E-3 | -- |

In addition to the doses from the releases of uranium, there is some small potential for doses from the technetium seeping from the evaporation ponds. Any dose that could result would occur if someone obtained their water supply from the groundwater flowing from the evaporation ponds to Joachim Creek. This area is currently part of the plant site and no individual lives in the area. In the unlikely situation that a person was to acquire his water from this area, it is expected that he would receive less than 1 mrem/year to the GI tract.

Solid wastes containing radioactive materials do not present a significant release source to the surrounding environment since they are contained, sealed, and disposed of offsite by licensed contractors.

### 5.2.2 Accidents

Two major accident scenarios which involve air releases were postulated and analyzed in detail. These are: (1) a large-scale release from a $UF_6$ cylinder, and (2) a criticality. These accidents are discussed below.

An incident resulting in a massive release of $UF_6$ is considered to be the bounding accident case for the release of uranium or fluoride. This accident would involve the release of $UF_6$ as might occur from valve or line failure of a heated cylinder being unloaded. Assuming that a full cylinder of $UF_6$ (2500 kg) at unloading temperatures started to leak and that no additional heat was supplied after cylinder failure, it is estimated that about 22 percent of the material would be released before the $UF_6$ could be considered to be cool enough to solidify and have a vapor pressure low enough so that the release stops. Such a release was estimated to last for 15 minutes and 540 kg of $UF_6$ would be released. It was assumed the uranium released would react with water in the air and form $UO_2F_2$ of a respirable particle size.

The results of the dose assessment for the accidental massive $UF_6$ release are shown in Table 5.2. The estimated maximum dose to the bone of the nearest resident is 0.82 rem. It is concluded that this type of

Table 5.2 Estimated Maximum Dose During Postulated Accidents at the CE Plant

| | Dose (rem) | Organ Dose (rem) | | | |
|---|---|---|---|---|---|
| | Total Body | Kidney | Bone | Lungs | Liver |
| Massive $UF_6$ Release Accident | | | | | |
| Nearest resident (800 M) | 0.05 | 0.2 | 0.82 | 0.016 | 0.05 |
| Criticality Accident | | | | | |
| Whole Body Gamma | | 0.27 rem | | | |
| Skin Beta | | 0.15 rem | | | |
| Thyroid | | 1.7 rem | | | |

accident would produce a dose to the nearest resident that, while not insignificant, does not greatly exceed the dose permissible from routine releases from the facility.

A second radiological accident, that of nuclear criticality, was examined. For the assessment, assumptions that are consistent with those presented in Regulatory Guide 3.34, "Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Uranium Fuel Fabrication Plant", are used. These include: a) a total of $1 \times 10^{19}$ fissions in 8 hours; (b) 100% of the noble gases resulting from the accident are released directly to the ventilated room atmosphere (c) 25% of the iodine resulting from the accident is released directly to the ventilated room atmosphere. No credit was taken for a stack because of its low elevation relative to the building roof.

The criticality accident was presumed to occur in the Oxide Building. Analysis shows that a criticality of an eight hour duration would result in moderate public exposure. Results presented in Table 5.2 show the whole-body-gamma dose, and thyroid dose to a nearest resident are 0.27 rem, and 1.7 rem, respectively. Guidelines for the radiological dose received by an individual during incidents involving a criticality do not exist, but dosage action levels recommended in EPA's "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents"[22] were used. The manual suggests that protective actions should be considered when the individual whole-body-gamma dose and thyroid dose are between 1-5 rems and 5-25 rems respectively. Comparing the estimated dosages that the nearest resident to the CE plant would receive during the criticality against those specified by EPA, it does not appear that protective actions such as sheltering for the nearest residents would be necessary if an eight hour criticality occurred.

## 5.3 NON-RADIOLOGICAL ASSESSMENT

The consequence of non-radiological effluents is addressed in two phases: routine plant operations and accidents. The assessment focuses on the environmental impacts caused by the potential release of fluoride and ammonia from the plant. While the State of Missouri does not have regulations for fluoride emissions, the American Conference of

Governmental Industrial Hygienists recommended threshold level value (TLV) of 2500 ug/$m^3$ was used as a guideline for evaluating the consequences of fluoride releases from the Hematite plant to humans. For vegetation, the Washington State standard of 3.7 ug/$m^3$ average concentration for a 12 hr period was used in evaluating accidental releases and the ambient air concentration of 0.5 ug/$m^3$ was used in evaluating normal releases[3].

### 5.3.1 Routine Plant Operations

A total quantity of 5,600 kg/yr of fluoride is estimated to be released from CE's plant. Ground level concentrations of fluoride for this 5,600 kg/yr release rate were calculated using annual average atmospheric stability data in the southwest direction toward the nearest resident. The results indicate that the ground level fluoride concentration would be less than 0.3 ug/$m^3$ at distances greater than about 625 meters. Thus the 0.5 ug/$m^3$ standard is not likely to be exceeded off the plant site. Liquid effluents containing HF are at low concentrations (less than 1.2 mg/l), which is below the 1.2 mg/l limit for fluoride discharge as specified in the NPDES permit. The amount of fluoride present in the liquid effluents would not cause any significant damage to the environment.

### 5.3.2 Accidents

Accidents that could occur at the Hematite plant are a massive release of $UF_6$ or a failure of the ammonia storage cylinder. In the accident involving $UF_6$ vapor release from a ruptured pipe or container, HF gas can be formed if $UF_6$ reacts with $H_2O$. This event will lead to a formation of about 175 kg of fluoride in the air. Using a simple plume dispersion model[23] to estimate the HF dispersion during the accident, the maximum HF ground level concentrations at the nearest residence (800 m) was estimated to be 0.8 to 12.5 mg/$m^3$ depending on the settling rate of $UO_2F_2$. This is above the TLV recommended level of 2500 ug/$m^3$. Short-term effects of this potential release are expected to be taste sensations and mild smarting of the nose and no long-term effects are expected.[2] Because of the short-term nature of the exposure (less than 1 hour), no long-term effects on local vegetation are anticipated.

The second accident assessed is one that would release a large quantity of ammonia. It is postulated that a major rupture could occur in a tank containing liquified ammonia under pressure which would instantaneously vent all of the stored ammonia to the air. The ammonia would form a dense cloud with a volume of about 15 cubic meters around the accident location. The ammonia cloud would be a heavy gas which would slump to the ground and spread due to gravity and surface wind velocity. Using an ammonia release model, which assumes negligible air entrainment, it is estimated that after about 10 seconds, a pancake shaped cloud of about 10 meter radius and a height of about 5 cm would result. This cloud would move in a downwind and downhill direction, entraining air and slowly increasing both in height and radius. These characteristic features of the movement of the ammonia-air plume have been confirmed and studied in many experimental and accidental cases involving major releases of ammonia.[24]

While it is generally accepted that air will be entrained into the cloud through its upper surface, there are no demonstrated and widely accepted models for predicting the rate of air entrainment. A reasonable calculation for gravity spreading and air entrainment for an ammonia release very similar in size to that postulated for the Hematite facility (20 tons) and for similar meteorological conditions (Class D stability and 10.8 kilometers per hour wind speed) has been presented by Kaiser and Walker[25]. This analysis predicts the zone of fatal concentration to humans could extend downwind from the release point for a distance of approximately 970 meters (0.6 miles), over level ground. Due to the facts that the nearest residences are located 3 meters (10 feet) or more higher than the elevation of the plant $NH_3$ storage site, and the topography at the site slopes away from the residents, the hazard to residents associated with such a release at the Hematite site would be expected to be less. Some ammonia burning of the local vegetation and killing of local fish due to $NH_4OH$ would be anticipated.

Other possible accidents such as flooding, tornado, earthquake, and failure of the HF scrubber system would not cause any non-radiological environmental impacts more significant than those resulting from the accident involving $UF_6$ release.

## 5.4 SUMMARY EVALUATION

Sections 5.1 and 5.2 have addressed the radiological and non-radiological consequences at the CE Hematite facility assuming that the plant continues to operate in a manner very similar to its past performance as summarized in Section 3.2.3. The analysis has shown that:

1. The dose to the nearest resident is expected to be significantly below the EPA Standards of 40 CFR 190. The dose for the critical organ (the lungs) is about .2% of the standard while for the other organs is about an order of magnitude less.

2. The dose is predominantly due to atmospheric discharges of uranium.

3. The doses due to liquid releases (both uranium and technetium) could, under extreme conditions, become a minor contributor to the public dose.

4. Fluoride emissions appear to result in concentrations which comply with Washington State Standards for residential locations.

5. The consequences of accidents, both radiological and non-radiological are expected to involve only short-term effects and to present no threat to the health and safety of the public.

## 6.0 MATERIALS AND PLANT PROTECTION

Current safeguards are set forth in 10 CFR Parts 70 and 73. The regulations in Part 70 provide for material accounting and control requirements with respect to facility organization, material control arrangements, accountability measurements, statistical controls, inventory methods, shipping and receiving procedures, material storage practices, records and reports, and management control.

The Commission's current regulations in 10 CFR Part 73 provide requirements for the physical security and protection of fixed sites and for nuclear material in transit. Physical protection requirements for special nuclear material of low strategic significance (including low enriched uranium) include provision for establishment of controlled access areas, monitoring these areas to detect unauthorized penetration, providing a response capability for unauthorized penetrations and activities, and establishing procedures for threats of theft and thefts.

The Commission's regulations in 10 CFR Parts 70 and 73, described briefly above, are applied in the reviews of individual license applications. License conditions then are developed and imposed which translate the regulations into specific requirements and limitations that are tailored to fit the particular type of plant or facility involved.

The licensee has an approved (August 28, 1980) material control and accounting plan and an approved physical security plan which meet the current requirements for the low enriched uranium which would be possessed at the site. It is concluded, therefore, that the safeguards-related environmental impact of the proposed action is insignificant.

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